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## CAUSALITY AND COMPLEMENTARITY*

NIELS BOHR

IN physics, causal description, originally adapted to the problems of mechanics, rests on the assumption that the knowledge of the state of a material system at a given time permits the prediction of its states at any subsequent time. However, a wholly new situation was created through the discovery of the universal quantum of action, which revealed an elementary feature of individuality of atomic processes far beyond the old doctrine of the limited divisibility of matter originally introduced as a foundation for a causal explanation of the specific properties of material substances. This novel feature is not only entirely foreign to the classical theories of mechanics and electro-magnetism, but is even irreconcilable with the idea of causality.

The very fact that quantum phenomena cannot be analysed on classical lines thus implies the impossibility of separating the behaviour of atomic objects from the interaction of these objects with the measuring instruments which serve to specify the conditions under which the phenomena appear. In this situation, an inherent element of ambiguity is involved in assigning conventional physical attributes to atomic objects. A clear example of such an ambiguity is offered by the dilemma concerning the corpuscular and wave properties of electrons or photons, where we are faced with the contrast revealed by the comparison between observations regarding an atomic object, obtained by means of different experimental arrangements. Such empirical evidence exhibits a novel type of relationship, which has no analogue in classical physics and which may conveniently be termed *complementarity*, in order to stress the fact that, in the contrasting phenomena, we have to do with two equally essential aspects of all well-defined knowledge about the objects. It is this complementarity which appears as a rational generalisation of the notion of causality.

The epistemological lesson we have received from the new development in physical science, where the problems enable a comparatively

* Abstracted from *Science*, 1950, **111**, 51.

concise formulation of principles, may also suggest lines of approach in other domains of knowledge where the situation is of an essentially less accessible character. An example is offered in biology, where mechanistic and vitalistic arguments are used in a typically complementary manner. In sociology too, such dialectics may often be useful, particularly in problems confronting us in the study and comparison of human cultures, where we have to cope with the element of complacency inherent in every national culture manifesting itself in prejudices which obviously cannot be appreciated from the standpoint of other nations.

Recognition of complementary relationship is not less required in psychology, where the conditions for analysis and synthesis of experience exhibits striking analogy with the situation in atomic physics. In particular, the place left for the feeling of volition is afforded by the very circumstance that situations where we experience freedom of will are incompatible with psychological situations where causal analysis is reasonably attempted. In other words, when we use the phrase "I will", we renounce explanatory argumentation.

Altogether, the approach towards the problem of explanation that is embodied in the notion of complementarity suggests itself in our position as conscious beings, and recalls forcefully the teaching of ancient thinkers that, in the search for a harmonious attitude towards life, it must never be forgotten that we ourselves are both actors and spectators in the drama of existence. To such an utterance applies, of course, the recognition that our task can only be to aim at communicating experiences and views to others by means of language, in which the practical use of every word stands in a complementary relation to attempts at its strict definition.

## CENTRAL DRUG RESEARCH INSTITUTE, LUCKNOW

THE Central Drug Research Institute, Lucknow, which was declared open by the Prime Minister, the Hon'ble Pandit Jawaharlal Nehru, on February 17, has for its functions the following:

(1) Promotion of drug research in general.
(2) Testing and standardizing drugs discovered in the Institute and providing expert advice for the further development and production of these drugs.
(3) To offer facilities and advice to scientists, universities, appropriate institutions, industries and others who may not be in a position to carry out or complete investigations on matters relating to drugs.
(4) To organise controlled clinical trials of drugs in hospitals and clinics.
(5) Dissemination of scientific knowledge relating to drugs.

The Institute will have the following divisions to begin with: (1) Chemistry; (2) Biochemistry; (3) Pharmacology; (4) Microbiology and Parasitology and (5) Clinical Science.

A sixth Division of Botany including Pharmacognosy is also likely to be included in the near future. In addition to these Scientific Divisions, there will be an Animal House, an Intelligence and Statistical Section including a Central Library, a Workshop for the fabrication of instruments, special glass apparatus and small type of pilot plants, a Construction and Maintenance Section, and a Museum.

From its inception, the Institute has had the advantage of the guidance of Col. R. N. Chopra, the pioneer of drug research in India.

## INTERNATIONAL COMMISSION FOR PLANT SLIDE EXCHANGES

THE aim of the Commission is to enable co-operating institutions and individuals to build up reference slide collections by exchanging plant materials sent in by them for slides processed from either these materials or from those forwarded by others. Any individual botanist, department of botany or botanical institution may become a member of the Commission upon payment in advance of an annual fee of ten dollars ($ 10·00, U.S. Currency). Fees will be used solely for overhead expenses such as the preparation of lists of slides, slide boxes, postage, clerical assistance, etc. Members are expected to collect and fix properly for slide-making purposes plant materials indigenous to their respective regions or collected elsewhere by themselves. All plants from the algæ on are to be included, as are all plant structures. The two standard microtechnique manuals should be used for guidance in collecting: Johansen, *Plant Microtechnique*, and Sass, *Elements of Botanical Microtechnique*. Any further information can be obtained from: Dr. D. A. Johansen, Chairman, International Commission for Plant Slide Exchanges, 861, East Columbia Avenue, Pomona, California, U.S.A.

# SOME OBSERVATIONS ON THE STRUCTURE AND CLASSIFICATION OF THE DHARWARS OF MYSORE STATE

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THE Dharwar Schists in Mysore have so far been considered as occurring in a few isolated well-defined bands. The earlier geologists described them under three separate units, the Shimoga belt, the Chitaldrug belt, and the Kolar belt. Rama Rao[1] further subdivided the first two belts according to their regional distribution and made the following five-fold grouping of the Dharwars of Mysore: (i) *Western* (Kodachadri, Agumbhe and Kuduremukha regions); (ii) *West Central* (Shimoga, Bababudan, Holenarsipur and Krishnarajpet regions); (iii) *Central* (Chitaldrug, Chiknaikanhalli and Nagamangala regions); (iv) *East Central* (Scattered stringers); (v) *Eastern* (Kolar region).

Such a geographical grouping has, of course, certain advantages for descriptive purposes, but this has tended to give unnecessary individuality to each of these belts, and even the proposed systems of classification of the Mysore Dharwars have been somewhat influenced by this regional consideration.

The main reason for the lack of progress in our knowledge of the detailed stratigraphy and tectonics of the Dharwars of Mysore was due to the belief held till recently that their constituent members were igneous in origin. Several of the earlier geologists have often referred in their writings to folds such as anticlines and synclines, but no area was worked out in any detail from the structural point of view, nor was the succession of beds determined. The geological map of Mysore on a scale of 8 miles to an inch which was published in 1915 under the direction of Dr. W. F. Smeeth is a valuable record of the mapping done so far, and though later work has shown that in some cases the boundaries require alteration, and the interpretation of rock types some modification, the main features can be taken as reasonably accurate. A study of this map shows that the Dharwar rocks especially in the northern half of the State have sinuous outcrops and have the appearance of festoons, a fact which indicates that the beds have been thrown into a series of folds.

One of the folds in the Dharwar rocks in the southern portion of the Chitaldrug Schist belt near Dodguni was recently studied in some detail.[2] It was seen that the component beds of the Dharwar Schists here are folded such that they generally dip away from the fold-axis. In the western limb of the fold the beds have a steep westerly dip, and the evidence of current bedding in the quartzites indicates that the beds in this limb young westwards. Similar observations made in the eastern limb of the fold showed that the rocks uniformly dip east and young eastwards. As the result of the use of this technique, it was found that the beds here are normal and not reversed, and that the nature of the fold is a true anticline. The noses of the beds are towards the north, a feature characteristic of a plunging fold. The pitch in this case was found to be in a north-north-west direction. The Dodguni fold is, therefore, a pitching anticline which closes northwards.

From the geological map of Mysore, it is seen that the folds closing southwards are pitching synclines. Two good illustrations are found—one north of the Sulekere tank in the Shimoga Schist belt, and the other south of Jogimardi in the Chitaldrug Schist belt.[3]

Banded ferruginous quartzite is a very characteristic component of the Dharwar System. Its resistance to erosion has proved invaluable in emphasising the structural pattern of the Dharwar rocks. There is one prominent ferruginous quartzite zone in Mysore which is also manganese-bearing and is associated very often with limestones. This is shown in the accompanying sketch map. Almost all the important manganese mines of the State are situated on this. In the writer's opinion, this zone should be of considerable value in the proper interpretation of the structure and classification of Mysore Dharwars.

This zone commences in the Western Ghats and after undergoing a few crumples near Kuduremukha and Mertiparvata, stretches practically due north through Shankargudda and Kumsi. The trend becomes sinuous, because of folding, southeast of Shikarpur and near Hosur, and proceeds eastwards along the border of the State till it meets the river Tungabhadra. From west of Malebennur, it strikes southeast till it is sharply folded back near Sulekere as a pitching syncline. The right limb runs north towards Hadadi. The trail is lost here because of the intrusion of the Peninsular gneiss, but we can pick it up again southeast of Anaji. After a short break, and

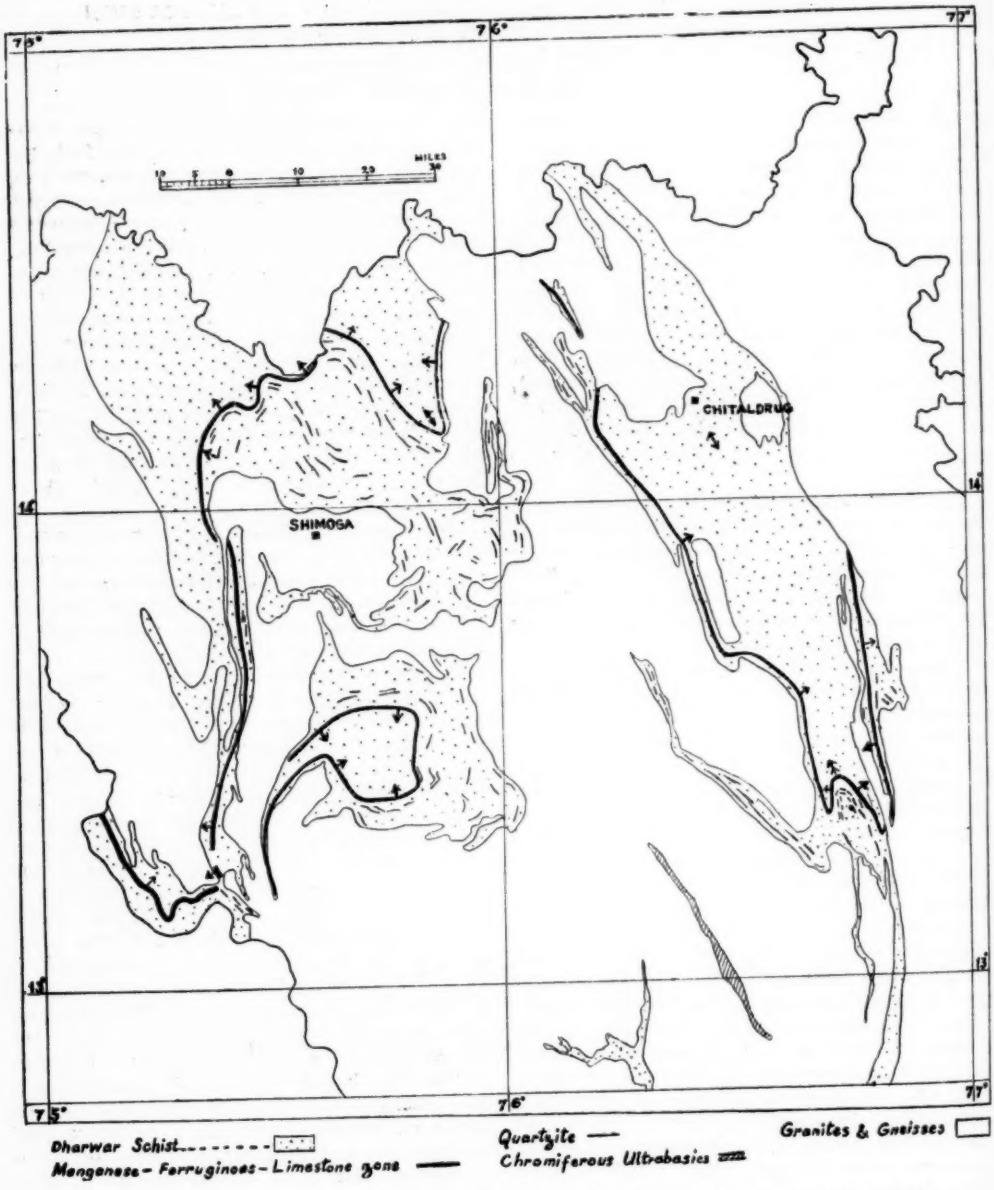


FIG. 1 Geological sketch map of the north-western part of Mysore State to illustrate the main structural eatures of the Dharwar Schists.

with probably a displacement due to faulting, the zone skirts the western margin of the greater portion of the Chitaldrug Schist belt, and passes through Shivgange, Madadkere, Mattod and Hatyal. At this place the zone is folded into the Dodguni pitching anticline, the right limb of which is sharply folded back. This continues almost due north to the east of Bukkapatna and disappears near Javagondanhalli.

The structure and disposition of this zone indicates that it is a huge anticlinorium with many minor anticlines and synclines, and having a general north-north-westerly pitch.

The Kolar Schist belt is comparatively a very small one and is too far removed from the other Schist belts of Mysore State to be of much use in the interpretation of the general structure of Mysore Dharwars. It is also separated from the other bands by the Closepet granites which runs right across the State in a north to south direction.

Attention will now be drawn to another very significant fact. A reference to the geological map of Mysore shows that numerous quartzite runs are found in the Schist outcrops below this prominent manganese-iron zone and none above it. The schist rocks near Kalasa, Mandagadde, Kumsi, Saulanga, Holalur, Joldhal, Hodigere, Tarikere, Chikmagalur, Chiknaikanhalli, Kondli, etc., are full of bands of quartzite of varying thickness and length. Many of them have well preserved ripple marks and current bedding.

On the other hand, quartzite runs are conspicuously absent in the area occupied by the Shimoga Schist belt towards the west of the Kumsi-Kalasa line. Similarly, the wide expanse of the Chitaldrug Schist belt east of the Anaji-Janehar line is devoid of quartzites. This fact should throw some light on the difficult problem of Dharwar classification.

The middle portion of this anticlinorium is extremely complicated. The Joldhal-Ubrani area is highly churned up and presents eddy structures of baffling complexity. The rock formations have been twisted and broken into small bits, so that they strike and dip in practically all directions of the compass.

Further south, the Bababudan area also presents some difficult tectonic problems. The iron formations occur in the shape of a horse-shoe with the opening on the north-west at Hebbe, but this opening is partially closed and gradually tapers towards the south. The iron formations do not contain workable deposits of manganese, and the association of limestone can only be inferred by the presence now of rhombs pseudomorphous after some carbonate.[4] Here again, the quartzites are found right round only on the outer margins of the hills[5] whereas no runs occur within the horse-shoe in the Jagar valley. The connection between this ferruginous band and the Kumsi-Kalasa zone has been severed by the intrusion of Peninsular gneiss, and so the relationships are not quite clear.

South of the 13th parallel, the Dharwar Schists outcrop in isolated stringers, lenses, and patches. They also exhibit a higher degree of metamorphism and so the elucidation of structure and stratigraphy is rendered extremely difficult. Near Chattanhalli, Sargur and Kandalike, the occurrence of discontinuous runs of limestone and quartzite are the only indications of the southern continuation of the Schist belts. In the extreme south of the State the strike veers towards the west, till finally many of the outcrops have an east-west direction. The zone of mylonite mapped by Jayaram[6] in the Kapini valley appears to demarcate the boundary between the two metamorphisms, one characterised by the NNW-SSE strike of rocks north-west of Heggaddevankote, and the other resulting in an almost E-W strike of rocks to the west and south of Sargur.

The workable deposits of chromite in Mysore occur only in a narrow band of ultrabasic rocks running in a north-west to south-east direction from Arsikere to beyond Nuggehalli, and again south of Mysore. It has always been difficult to explain this, but in the structure of the Dharwar schists proposed in this note, it is seen to occupy a central position in the anticlinorium. The chromiferous ultrabasic rock was probably intruded along the core or axial plane of this huge fold.

A new interpretation is offered in this paper regarding the geological structure of the Dharwar Schists of Mysore. It is hoped that this would throw further light on the problem of classification of these ancient rocks.

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# EFFECT OF AMINOPTERIN ON THE UPTAKE OF RADIOACTIVE PHOSPHORUS BY SOME ENDOCRINE TISSUES OF THE RAT

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THE potent folic acid antagonists, aminopterin (4-amino folic acid) and amethopterin (4-amino-$N^{10}$-methyl folic acid) are being extensively employed for the amelioration of certain types of leukemia and other neoplastic diseases.[1,2] These antimetabolites induce a folic acid deficiency in the rat and other animals. The report of the deleterious effect of folic acid or pteroylglutamic acid (PGA) deficiency on the body growth has led to the question of the mechanism involved. Hertz[3–6] has shown that the oviducts of PGA deficient chicks respond less readily to the effects of estrogen than those of normal or PGA treated chicks. This effect was not shown in other B-vitamin deficiencies. Marvin, Totter and Day[7] have studied the effects of PGA deficiency and PGA replacement on the endocrine glands of the immature chick. Their observations appear to show a primary disturbance involving diminished pituitary activity, retardation of thyroid development and hyperplasia of the tubules of the testes. Since endocrine substances and vitamins often affect the same physiological processes either in the same direction or antagonistically, it became of interest to study the uptake of radioactive phosphorus ($P^{32}$) by some of the endocrine tissues of the rat after treatment with aminopterin.

Inbred Wistar strain male rats, weighing between 180-250 gm., raised on our standard laboratory ration, were used. One group of rats received aminopterin at a level of 0·23 mg. per kg. for seven days. No treatment was given on the eighth day. After fasting for 14 hours, the animals received aminopterin at a level of 8·33 mg. per kg. on the morning of the ninth day. This was immediately followed by intraperitoneal administration of radioactive* disodium phosphate in normal saline. The total amount of phosphate administered was physiologically negligible, being less than 0·2 mg. The animals were sacrificed after two hours and the tissues were removed, weighed on a Roller-Smith torsion balance and digested. The animals of the control group were treated in the same way except that in the place of aminopterin, they received corresponding volumes of normal saline. A third group of animals fasted for 14 hours, received a single massive dose of aminopterin at a level of 8·33 mg. per kg. immediately prior to the administration of radioactive phosphorus. All groups of animals were sacrificed two hours after the administration of the labelled phosphate. The tissues were digested at 120° C. in an oven for several hours with sulphuric acid followed by frequent addition of concentrated nitric acid. The clear digest was diluted with water and hydrolysed at 100° C. for 15 minutes. The orthophosphate was precipitated as the magnesium-ammonium complex by the method of Sacks and Sacks as described by Cori and Cori.[8] The precipitates were collected at the centrifuge, washed twice with 2·5 ml. of 2·5 per cent. ammonia and dried in an air oven at 100° C. They were brought into solution in a suitable volume of 5 per cent. hydrochloric acid. Aliquots were plated[9] out on stainless steel cups, 2 × 0·4 cm., and dried in an air oven at about 60° C. Measurements of radioactivity on the dry samples were made with G.M. 4 Geiger counter tubes (General Electric Co., Ltd.) and a scaling unit, type SC-200 (Dynatron Radio Ltd.). All samples were placed in the lead castle at the same distance from the counter. The results, average of 4 animals from each group, are presented in the table given below:

*Effect of Aminopterin on the Uptake of $P^{32}$ by the Endocrine Tissues of the Rat*

| | Testes | | Thymus | | Thyroid | | Adrenal | |
|---|---|---|---|---|---|---|---|---|
| | (*a*) | (*b*) | (*a*) | (*b*) | (*a*) | (*b*) | (*a*) | (*b*) |
| Control | 2·3 | 1·4 | 23·8 | 11·8 | 14·1 | 7·0 | 16·3 | 8·4 |
| Cumulative dose | 2·1 | 1·0 | 22·9 | 11·6 | 30·3 | 14·2 | 8·0 | 3·8 |
| Single dose | 2·1 | 0·9 | 25·2 | 10·8 | 25·2 | 11·0 | 25·6 | 11·1 |

Aminopterin and normal saline were injected subcutaneously. All animals received 50$\mu c$ of $P^{32}$ intraperitoneally. The results are expressed:

(*a*) $\frac{\text{Cpm. per g tissue}}{\text{Cpm. administered per gm. body weight}} \times 10$,

(*b*) Cpm. per gm. tissue as parts per thousand of the dose administered.

No data or observations are presented with regard to the uptake of $P^{32}$ by the pituitary. Aminopterin seems to have no influence on the

* Obtained through the kindness of the Isotopes Division, A.E.R.E., Harwell, England.

uptake of $P^{32}$ by the testes. Probably this finding offers an indirect support to the observations of Goldin and co-workers[10] on the inability of testosterone propionate to reverse the toxicity of aminopterin in mature male mice. Although Higgins[11] has observed the atrophy of the thymus following the treatment with aminopterin, no significant differences in the uptake of radioactive phosphorus could be found. Of the endocrine tissue studied, adrenal and thyroid need special comment. Higgins[11] has also observed hypertrophy of the adrenal glands after treatment with aminopterin. A single massive dose of the antimetabolite just two hours prior to the sacrifice increases the uptake of $P^{32}$ significantly over the control. This would indicate an heightened metabolic activity of the secretory tissue. The uptake of $P^{32}$ by the adrenals of rats which have received cumulative dose is considerably lower compared to the normal. Probably, in these animals with the development of more secretory units of the adrenals, the rate of metabolic activity is diminished. A single dose of aminopterin markedly raises $P^{32}$ uptake by the thyroid gland indicating an increased metabolic activity of the gland. In animals which have received cumulative dose of the antimetabolite, the uptake is slightly higher compared to the animals which have received a single dose. It appears that aminopterin enhances the metabolic activity of the thyroid gland probably through the pituitary or the adrenal. The above observations on the uptake of $P^{32}$ by the adrenal and the thyroid under the influence of aminopterin, seem to substantiate the observations of other workers[12–14] on the interrelationship between the functional activity of the adrenal cortex and thyroid secretory levels under totally different conditions.

The effect of aminopterin on the uptake of $P^{32}$ by the adrenals cannot be wholly explained on the basis of a "stress" reaction, in view of two other important observations, however indirect they may be. The first relates to the elimination of the differential sex toxicity in mice[10] to the antifolic acid compound after adrenalectomy. Secondly,[15] patients treated for metastatic cancer with aminopterin, show a unique reduction in the excretion of reducing corticoids (11-oxysteroids) with no parallel change in the excretion of 17-ketosteroids. Under conditions of "stress" the excretion of reducing corticoids (11-oxysteroids) is generally found to be increased together with 17-ketosteroids.

We are thankful to Dr. A. R. Gopal-Ayengar, Chief Research Cytologist, for his kind help and interest in this investigation. We are indebted to Lederle Laboratories (India) Ltd., for a generous gift of aminopterin required in this work. This investigation is aided by grants from the Atomic Energy Commission of the Government of India.

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## UNESCO AND TECHNICAL ASSISTANCE TO INDIA

ACCORDING to a recent agreement between the UNESCO and the Government of India, the UNESCO will provide 10 specialists to work in India, *two* of whom would work in the National Laboratories (Physical and Chemical), *three* in the Indian Institute of Technology, Khargpur, *three* in the Research Laboratories of the Central Waterpower, Irrigation and Navigation Commission, and *one* each in the Birbal Sahni Institute of Palæobotany, Lucknow, and the Central Institute of Education, Delhi.

Technical and other equipment to the extent of $ 22,000 will be supplied by UNESCO. In addition, the UNESCO has agreed to consider requests for additional essential equipment required for the work of specialists. The UNESCO has also agreed to award fellowships and study grants to the extent of $ 22,000 to selected Indians who would eventually replace these specialists.

Proposals in regard to the establishment of a Scientific Bibliographical Centre in India are under consideration of the Government of India and the UNESCO.

# STUDIES ON THE INTER-RELATIONSHIP AMONG VITAMINS AND AMINO-ACIDS

## Influence of Desoxy-pyridoxine on the Bio-synthesis of Nicotinic and Ascorbic Acids in Germinating Pulses

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TRYPTOPHANE-NICOTINIC acid interrelationship first demonstrated with rats,[1,2] has been extended to other mammals[3,4,5] plants and micro-organisms, and such studies have been widened to include other vitamins and amino-acids. It has been shown for example that tryptophane serves as a niacin precursor in the case of the fungus neurospora by way of kynurenine and 3-hydroxy anthranalic acid.[6,7] Seeds are known to give rise to increased amounts of thiamine,[8] nicotinic acid and riboflavin,[9] pyridoxine,[8] and ascorbic acid,[10] during germination. But it was found that a tryptophane-niacin relationship did not exist in the case of bean seedlings grown without their cotyledons on synthetic media.[11] Nason[12] has, however, shown that a tryptophane-niacin relationship similar to that found in certain mammals and *Neurospora*, does exist in higher plants like the corn and has studied the effect of *l*-tryptophane and vitamin $B_6$, individually as well as in combination. He concluded that niacin synthesis is a direct function of the supply of *l*-tryptophane and is independent of the vitamin $B_6$ used, since addition of vitamin $B_6$ to the medium did not significantly increase niacin synthesis. Banerjee and Banerjee[13] have shown that in the case of *Phaseolus mungo* addition of vitamin $B_6$ to the medium does not enhance the bio-synthesis of niacin. In the case of ascorbic acid, however, the effect of the addition of several nutrients during germination on the bio-synthesis of this vitamin has been studied.[10,14,15,16] But there appears to be no general agreement on the specific constituents which promote such bio-syntheses. Thus, the beneficial influence of salts, of manganese and mannose have been shown by some, while others have not been able to confirm these observations. In the case of rat, some data of a controversial nature, as regards ascorbic acid content in various tissues have been obtained in 1939 by Sure and his associates.[17] Studies have, therefore, been undertaken first with germinated seedlings with a view to elucidate these problems. Cereals and pulses contain appreciable amounts of vitamin $B_6$[18,19] which increases during germination.[8] Any study of the influence of vitamin $B_6$ on the inter-relationship between tryptophane and nicotinic acid and on the bio-synthesis of ascorbic acid should therefore take into account the initial presence of $B_6$ in the seed before germination. In order to counteract the influence of vitamin $B_6$ already present, a competitive inhibitor like desoxy-pyridoxine[20,21] was added to the medium during germination. It was then found that the bio-synthesis of nicotinic and ascorbic acids could be greatly influenced by vitamin $B_6$ during the course of germination of several pulses.

### EXPERIMENTAL

(*a*) *Germination.*—Green-gram (*Phaseolus mungo*), cow-pea (*Vigna sinensis*) and red-gram (*Cajanus cajan*) have been used in the course of these experiments. Seeds (5 gm. for nicotinic acid and 2 gm. for ascorbic acid) were sterilised with 0·1 per cent. mercuric chloride solution, washed and transferred into sterile petri-dishes containing a layer of acid-washed (B.D.H.) sterile sand. Sterile glass-distilled water was added to each dish in requisite amounts. Necessary amounts of the sterilised solutions of the chemicals were added to particular dishes. The petri-dishes were kept away from direct sunlight in a sterile chamber. The mercuric chloride washed seeds on crushing and plating out in a nutrient medium were found to be free from any bacterial contamination. The germination was carried out for the number of hours specified in the data presented (Tables I and II).

(*b*) *Estimation of nicotinic acid plus nicotinamide in dry and germinated seeds.*—Dry powdered seeds were directly weighed out (5 gm. lots) into conical flasks. After requisite period of germination the seeds from each petri-dish were separately ground with 30 ml. water and transferred quantitatively into conical flasks. 10 ml. of 12 N. sulphuric acid were added, boiled over a water-bath, centrifuged after cooling, made up to 50 ml., washing the residue twice or thrice. The nicotinic acid was determined colorimetrically using lead acetate and zinc sulphate for the deproteinisation; the colour produced by cyanogen bromide and aniline was measured in a photo-electric colorimeter according to the method described by Hawk, Oser and Summerson.[22]

(*c*) *Estimation of ascorbic acid.*—Samples, before and after germination, were ground in a mortar to a fine paste with 6 per cent. freshly

TABLE I

NICOTINIC ACID

*(Figures are expressed in γ per gram of dry material)*

| Dish No. | Substances used in the medium | Hours of Germination | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | *Phaseolus mungo*-nicotinic acid in dry seed-20·8γ/g. | | | *Vigna sinensis*-nicotinic acid in dry seed-15·4γ/g. | | | *Cajanus cajan*-nicotinic acid in dry seed-19·6γ/g. | | |
| | | 24 hrs. | 48 hrs. | 72 hrs. | 24 hrs. | 48 hrs. | 72 hrs. | 24 hrs. | 48 hrs. | 72 hrs. |
| 1 | 30 ml. Water (control) | 24·7 | 30·5 | 39·8 | 18·4 | 23·9 | 27·2 | 22·3 | 27·9 | 30·6 |
| 2 | 20 ml. Water *plus* 400γ desoxy-pyridoxine in 10 ml. Water | 19·6 | 22·3 | 28·2 | 15·2 | 17·4 | 19·8 | 19·9 | 23·7 | 23·8 |
| 3 | 10 ml. Water *plus* 400γ desoxy-pyridoxine in 10 ml. Water *plus* 7 mg. pyridoxine in 10 ml. Water | 24·0 | 29·9 | 38·3 | 17·9 | 24·1 | 26·3 | 21·8 | 25·9 | 29·5 |
| 4 | 20 ml. Water *plus* 20 mg. *dl*-Tryptophane in 10 ml. Water | 25·8 | 31·6 | 40·2 | 19·1 | 25·2 | 27·4 | 23·2 | 28·2 | 30·1 |
| 5 | 10 ml. Water *plus* 20 mg. *dl*-Tryptophane in 10 ml. Water *plus* 400γ desoxypy-ridoxine in 10 ml. Water | 20·1 | 23·2 | 29·3 | 15·8 | 17·1 | 20·2 | 19·4 | 24·1 | 23·6 |
| 6 | 20 mg. *dl*-Tryptophane in 10 ml. Water *plus* 400 γ-des-oxy-pyridoxine in 10 ml. Water *plus* 7 mg. pyridoxine in 10 ml. Water | 24·2 | 30·5 | 38·9 | 18·4 | 24·3 | 25·6 | 22·1 | 26·3 | 29·1 |

TABLE II

ASCORBIC ACID

*(Figures are expressed in mgm. per 100 gram of dry material)*

| Dish No. | Substances used in the medium | Hours of Germination | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | *Phaseolus mungo* (Ascorbic acid in dry seed = 6·37 mg./100 g.) | | | | | | | | |
| | | Water in the medium | | | 5 ml. of 2½% sol. of Glucose in the medium | | 5 ml. of 5% sol. of Glucose in medium | 5 ml. of 2½% sol. of Mannose in the medium | | 5 ml. of 5% sol. of Mannose in medium |
| | | 24 hrs. | 48 hrs. | 72 hrs. | 48 hrs. | 72 hrs. | 48 hrs. | 48 hrs. | 72 hrs. | 48 hrs. |
| 1 | 15 ml. Water (control) | 32·7 | 42·31 | 51·81 | 30·73 | 36·78 | 30·84 | 34·65 | 50·05 | 34·60 |
| 2 | 10 ml. Water *plus* 125γ des-oxyp-yridoxine in 5 ml. Water | 31·0 | 19·16 | 19·65 | 18·73 | 22·06 | 18·60 | 34·33 | 47·43 | 34·05 |
| 3 | 5 ml. Water *plus* 125 γ des-oxyp-yridoxine in 5 ml. Water *plus* 1250 γ pyridoxine in 5 ml. Water | 31·26 | 41·05 | 54·49 | 23·93 | 35·35 | 27·05 | 34·36 | 49·39 | 33·77 |

prepared *meta*-phosphoric acid, glass-distilled water being used throughout these experiments. The ground sample was transferred quantitatively to a 50 ml. centrifuge tube and the contents centrifuged, the supernatant decanted and the residue again extracted three times in a similar manner. The total extract was made up to a known volume and titrated against 0·2 ml. of the standard indophenol dye according to the method of Harris and Olliver.[23] These values were confirmed by the colorimetric method of Stotz and Robinson.[24]

### Results and Discussion

The results obtained for the bio-synthesis of nicotinic acid and ascorbic acid during germination of some of the pulses are presented in Tables I and II respectively. It will be seen from Table I that during germination of pulses in water medium alone there is a gradual increase of nicotinic acid. The addition of desoxy-pyridoxine during germination markedly inhibits this increase, but the decrease in value does not fall below the original nicotinic acid value of the seed. The addition of pyridoxine hydrochloride in the concentration specified abolishes this inhibitory effect of desoxy-pyridoxine. The presence of *dl*-tryptophane in the medium to the extent of 20 mg. exerts only a slight influence, if at all, on the increase in the nicotinic acid. The more sensitive microbiological method for the detection of these smaller differences in nicotinic acid is proposed to be used in future experiments to confirm these results. But, as in the case of water medium, addition of desoxy-pyridoxine to the tryptophane medium exerts a similar deleterious effect on the increase of nicotinic acid which, however, is counteracted when pyridoxine is simultaneously added into the medium along with desoxy-pyridoxine. These results, therefore, clearly suggest that $B_6$ influences the conversion of tryptophane to nicotinic acid. The fact that *dl*-tryptophane added to the medium does not increase the nicotinic acid shows that the seed has enough of this amino-acid liberated or made available during the course of its germination. However, some preliminary experiments indicate that when *l*-tryptophane is added to the medium in similar amounts there is greater increase in the nicotinic acid of these pulses during germination, even though there is enough of this amino-acid originally in the seed. Whether the conversion of *l*-tryptophane to nicotinic acid is more rapid than with *dl*-tryptophane and whether vitamin $B_6$ has any role to play as a "coracemase" as suggested by Snell[25] remains to be investigated.

The results for ascorbic acid content of pulses under different conditions of germination are presented in Table II. As in the case of nicotinic acid, there is a steady increase in the vitamin C content during germination, though the increase is not as large as reported by other workers. But, what perhaps has been observed for the first time is the fact that by the addition of desoxy-pyridoxine, the influence of vitamin $B_6$ has been considerably affected on such a synthesis and only a small increase in the vitamin C content is observed. The large addition of pyridoxine to the medium, however, counteracts the anti-vitamin effect of desoxy-pyridoxine and the normal increase of vitamin C content during germination is again noticeable.

Another interesting observation made in the course of these studies was the effect of added glucose and mannose into the medium during germination. It will be seen from the results that when 5 ml. of water is replaced by an equal volume of 2·5 per cent. solution of glucose, the deleterious effect of desoxy-pyridoxine was observed, while with mannose solution no such deleterious effect could be noticed. These results indicate that vitamin $B_6$ influences the first stage of conversion of glucose into mannose but not the conversion of mannose into ascorbic acid. Whether vitamin $B_6$ is acting here also like a "coracemase"[25] by influencing isomerisation *in vivo* of glucose to mannose remains to be elucidated. Further work is in progress.

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## THE SPECTRUM OF DOUBLY-IONISED TANTALUM

THE spectrum of a highly condensed spark between rods of pure tantalum (1) in air, (2) under water, and (3) in hydrogen was photographed with quartz and glass Littrow Spectrographs. Comparative study of the occurrence and intensity of the lines in the spectra of the arc, under water spark and highly condensed spark, with and without a series inductance, helped in the selection of lines due to the second spark spectrum of tantalum. These were particularly abundant in the region λ 2250 to λ 2750.

Of the spectra of Lu—I and Hf—II, *iso*-electronic with Ta III, only the ground term interval

$$5d6s^2\ (^2D_{3/2}-{}^2D_{5/2})$$

was identified by Meggers and Scribner. An approach to Ta III through *iso*-electronic spectra could not therefore take us farther than estimating the probable value of the above interval in Ta III as 4200 cm.$^{-1}$ However, as V III and Cr III spectra are known, recourse could be had to the extrapolation of the $6s\,^4F$ term intervals of those spectra to the corresponding ones in Ta III. It is interesting to note that though there is no chemical similarity in V III, Cb III and Ta III for the ground terms, for the $md^2ms$ terms, however, there is perfect similarity as they arise from the $d^2s$ configuration in all the three spectra. An application of the useful though empirical rule of proportionality of the logarithm of term interval to that of the atomic weight of the element to the

$$6s\ (^4F_{5/2}-{}^4F_{7/2}) \text{ and } 6s\ (^4F_{7/2}-{}^4F_{9/2})$$

intervals lead to an approximate estimate of those intervals and, through a search for recurring differences of that order in Ta III lines, to the regularities presented in the Tables below:

| | $5d\,6s^2\ {}^2D_{5/2}$ | (4238·9) $^2D_{5/2}$ |
|---|---|---|
| $6p\ {}^4F_{5/2}$ | 42596·1 (8) | 38358·6 (6) |
| $^4D_{1/2}$ | 41747·5 (6) | |
| $^4D_{3/2}$ | 42472·0 (8) | 38233·6 (6) |

| | $^4F_{3/2}$ | $^4F_{5/2}$ | $^4F_{7/2}$ | $^4F_{9/2}$ |
|---|---|---|---|---|
| $p^4F_{3/2}$ | 40622·2 (8) | 38766·8 (5) | | |
| 2084·6 | | | | |
| $^4F_{5/2}$ | 42705·8 (7) | 40851·9 (8) | 38233·6 (6) | |
| 2405·3 | | | | |
| $^4F_{7/2}$ | | 43256·9 (10) | 40639·1 (5) | 37493·9 (2) |
| 2083.5 | | | | |
| $^4F_{9/2}$ | | | 42722·8 (8) | 39577·2 (4) |
| | | | | |
| $^4D_{1/2}$ | 41856·7 (8) | | | |
| 726·0 | | | | |
| $^4D_{3/2}$ | 42582·7 (6) | 40726·2 (9) | | |
| 1466·2 | | | | |
| $^4D_{5/2}$ | 44047·5 (6) | 42193·7 (3) | 39577·2 (4) | |
| | | 43285·5 (3) | 40669·7 (9) | 37523·8 (7) |

It is interesting to note from the tables that intensity rules are well obeyed as also the interval rules for higher $j$-values than is usually observed in complex spectra.

Presidency College, Madras, *February* 6, 1951.

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## PAPYROGRAPHIC SEPARATION AND LOCATION OF ANTIBIOTICS FROM PLANTS

THE antibiotic activity of the crude aqueous, alcoholic and ether extracts of the leaves of *Toddelia aculeata*, a reputed specific for dysentry, having been first found by one of us (Sirsi, M.) against the gram negative *Bact. flexneri*, it was of interest to determine if a papyrographic separation of the active principle could be accomplished.

A filter-paper strip (400 mm. × 20 mm. Whatman No. I) was spotted at one of its ends with a drop of crude ether extract and dried.

A glass tube (450 mm. × 30 mm.) vertically held, lined with filter-paper moistened with ether-saturated water, was employed as the developing chamber. The tube ground at both ends was provided with wooden corks. The lower cork supported the glass trough which contained the water-saturated ether for developing the papyrogram. The cork at the top had a glass rod, the end of which was drawn into a hook from which the paper strip could be hung vertically by means of a hole punched at the opposite end of the strip. The glass rod was carefully lubricated with vaseline, so that the strip could be raised or lowered within certain limits.

After placing the water-saturated ether in the trough, the cork carrying the glass rod and the paper strip, was carefully inserted into the tubular chamber, so that the strip was kept hanging just a few millimetres above the surface of the developing solvent and without touching the sides of the chamber. The strip was allowed to remain in this position for a couple of hours, so that the filter-paper was equilibrated with the vapour phase in the chamber. By carefully pushing down the glass rod, the strip could be so lowered into the trough, that just a few millimetres of the strip dipped into the solvent, leaving the spotted area clearly above the surface of the solvent. With the capillary rise of the solvent, the papyrogram was developed. The solvent front took about 4 to 5 hours to reach the top. The rise of the solvent front could easily be followed since, it almost agreed with simultaneous ascent of the chlorophyll band. The strip, after development, is air dried and cut lengthwise into two halves. One half was employed for the bioautographic location of the "active" zone,[1] while the other was used for ultraviolet printing of the papyrogram on Illford Reflex Paper.[2,3] Figs. 1 (*a*) and 1 (*b*) give photographs of the clearance on the agar plate seeded with *Staph. aureus* and the ultraviolet print. It will be observed that the zone of clearance is identical with the zone of ultraviolet absorption, suggesting that the antibiotic principle has an absorption in the ultraviolet region (253·7-265 $m\mu$), a fact of considerable significance in further investigations. The circumstance that the antibiotic zone lies adjacent to the chlorophyll band is also helpful in locating the "active" region and for eluting out the antibiotic from the incised portions of the papyro-

gram. The method of combining bioautographic technique with the ultraviolet printing of the papyrogram, which has been successful in the present instance, has immense potentialities of application in a study of antibiotics from natural sources.

FIG. 1. *a*. FIG. 1. *b*.

FIG. 1*a*. Area of clearance. (Bioautography against staph. aureus).

*b*. Photograph of the Papyrogram of the antibiotic from an Etherial extract of Toddalia aculeata, taken in the Ultra Violet region. (253·7 and 265 mμ).

C. Absorption due to Chlorophyll

D. Absorption due to "Active" fraction.

Our grateful thanks are due to Drs. N. N. De, K. P. Menon and A. S. Ramaswamy for their helpful discussions, and to Prof. M. S. Thacker for his kind interest.

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## STRUCTURE OF THE NEEM (*AZADIRACHTA INDICA*) GUM

THE gum from the tree was purified by precipitation with alcohol from a concentrated acidified solution of the gum, and obtained as a white powder. Sulphated ash 0·92% : $[\alpha]_D^{31·5°}$ —70·6° (c, 0·3344 in water); pentosans 15·9%; pentoses calc. on the basis of pentosans 18%, galactose residues calculated as $C_6H_{10}O_5$, 10·2% (from the yield of mucic acid obtained on oxidation of the polysaccharide with nitric acid). The gum did not give insoluble copper salt and did not reduce Fehling's solution.

The acidity of the gum was not sufficient for autohydrolysis. It was, therefore, hydrolysed with 0·05 N-sulphuric acid on water-bath (90-95°). The hydrolysis was complete in about 24 hours as determined by polarimetric and iodometric[1] observations.

The solution was cooled, neutralized with barium carbonate and filtered. The filtrate was concentrated in vacuum (bath temperature 40°) and the residue extracted with dry methanol. The methanolic extract was concentrated to a syrup which reduced Fehling's solution. It was verified to contain arabinose by forming the diphenyl-hydrazone (M.P. 195-96° alone or admixed with an authentic specimen).

The barium salt of the polysaccharide left behind after methanol extraction was further hydrolysed with 2N-sulphuric acid. The course of hydrolysis was again followed by polarimetric and iodometric observations. When the hydrolysis was complete, the solution was neutralized with barium carbonate, filtered and the solution concentrated at 40°/12 mm. The concentrated syrup was exhaustively extracted with methanol and the extract evaporated. The residue, a syrup, on treatment with methylphenylhydrazine gave D-galactose methylphenylhydrazone (M.P. 180-81° alone or admixed with an authentic specimen).

The structure of the aldobionic acid present in the gum is being worked out by methylation and hydrolysis.

Examination on the paper chromatogram of the sugars produced by the hydrolysis of the gum indicated the presence of galactose, arabinose and another sugar derivative which is most probably glucuronic acid. The chromato-

gram was developed by the improved method of Trevelyan, Procter and Harrison.[2]

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## INFLUENCE OF VITAMIN $B_{12}$ ON THE BIOLOGICAL VALUE OF A LOW QUALITY PROTEIN DIET

SEVERAL workers[1–3] have reported on the greatly enhanced growth resulting from 2 to 3 per cent. supplementation of poultry rations high in vegetable proteins with sources of 'Animal Protein Factor' (APF). This effect has since been attributed to the vitamin $B_{12}$ in APF.[4–6] The association of vitamin $B_{12}$ with protein utilisation has been more specifically demonstrated by observations that it influences transmethylation processes,[7–11] reduces renal injury in experimental animals receiving low choline diets,[12,13] enhances utilisation of circulating amino acids[14] and, generally speaking, plays 'a fundamental role affecting the capacity of the mammal to utilise proteins'.[15]

The present report relates to the influence of vitamin $B_{12}$ on the biological value, determined on three pairs of litter mate adult male rats, of a poor protein diet composed of (percentages): wheat flour, 60; defatted groundnut flour, 10; groundnut oil, 4; salt mixture (U.S.P. No. 2), 4; shark liver oil, 2; and vitaminised sucrose, 20. The vitamin additions were such that they provided the following quantities (milligrams) per kilogram of diet: thiamin hydrochloride, 2; riboflavin, 6; pyridoxine hydrochloride, 2; nicotinic acid, 20; calcium pantothenate, 10; inositol, 200; *a*-tocopherol, 25; and menadione, 5. Vitamin $B_{12}$ (Chas. Pfizer: oral grade) was added to the diet of one member of each pair of rats at the rate of 150 gamma per kilo. An *iso*-caloric protein-free diet for endogenous metabolism was secured by the substitution of 66 per cent. maize starch for the two flours and by increasing the groundnut oil addition to 8 per cent. The diets unsupplemented by vitamin $B_{12}$ were nearly free from assayable amounts of this vitamin. Biological values were determined essentially by Mitchell's balance sheet method[16] which in preliminary experiments with casein gave a mean biological value of $82{\cdot}6 \pm 0{\cdot}33$ and a mean digestibility coefficient of $98{\cdot}1 \pm 0$.

The cereal-legume mixture employed in these studies was on a 10 per cent. potein level (7·86 per cent. wheat protein *plus* 2·83 per cent. groundnut protein) and the diet provided 0·11, 0·26, 0·19 and 0·15 percentages respectively of tryptophane, methionine, lysine and cystine as compared to the percentages 0·19, 0·48, 0·74 and 0·39 respectively of these amino acids in an equi-protein casein diet. It was therefore considered poor in quality. The biological values of the vitamin $B_{12}$—supplemented and control groups were $75{\cdot}85 \pm 0{\cdot}98$ and $68{\cdot}08 \pm 0{\cdot}71$ respectively, while the corresponding digestibility coefficients were $90{\cdot}01 \pm 0{\cdot}037$ and $81{\cdot}96 \pm 2{\cdot}93$. The differences were significant.

It is recognised that the method employed here for assessment of protein quality in relation to vitamin $B_{12}$ gives only an over-all information and does not throw light on requirements for individual metabolic processes. Further work on hyperthyroid animals and on rate of liver protein regeneration and hæmopoiesis as influenced by vitamin $B_{12}$ with and without certain amino acid additions, particularly methionine, to low quality vegetable protein diets, is in progress.

A preliminary communication by Henry and Kon,[17] showing a favourable influence of vitamin $B_{12}$ on the assimilation of nitrogen as casein by the vitamin $B_{12}$-deficient rat, has just come to the notice of the authors.

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## INFLUENCE OF XANTHINE ON BIOGENESIS OF FOLIC ACID BY *LACTOBACILLUS ARABINOSUS*

THE synthesis of folic acid activity by several species of bacteria which do not require preformed folic acid (FA) has been reported[1–6] and related to the *para*-amino benzoic acid (pABA) content of the medium.[2,3,6] In the course of investigations, now in progress, on the involvement of FA in purine metabolism, it has been observed that other cultural additions besides pABA exert an influence on FA biogenesis by *Lactobacillus arabinosus* 17-5.

The basal medium employed for these studies was a nicotinic acid test medium[7] modified by the omission of pABA and inclusion of nicotinic acid (40 μg. per cent.). FA activity was measured with *Streptococcus lactis* R. (SLR) turbidimetrically[8]; for assays, the tubes were incubated at 37°.

Activity in the harvested cells was negligible while enzyme hydrolysis[8] of the culture filtrate did not make any difference in its assayable FA. Synthesis was maximum at the end of 48 hrs. incubation and increased from 13·8 milligamma (control) to 470 milligamma per cent. with pABA additions up to 2 gamma per cent. There was pronounced enhancement in FA activity as a result of biotin addition and, even more so, with xanthine. Other nutrients like adenine, guanine, uracil, nicotinic acid, thiamine riboflavin, vitamin $B_{12}$ and fermentation animal protein factor showed definite and varying degrees of stimulation.

The effect due to biotin (1 gamma per cent.) could also be secured by Tween 80 (0·1 per cent.), suggesting that it was probably on account of increased utilisation of nutrients as a consequence of enhanced cell permeability through surface activation. With xanthine, an addition of 0·03 per cent. had a stimulatory effect of about 2·6 times. The action of xanthine as precursor could only be explained on the basis of its providing a component unit of the FA molecule other than the pABA and presumably the pteridine moiety. The effect of glutamic acid, the third component of the FA molecule could not be assessed properly as casein hydrolysate was the nitrogen source in the medium.

The recent recognition of FA in natural sources in the form of the physiologically more active *citrovorum* factor (CF)[9,10] together with the observed occurrence of this in fermentation liquors,[11–13] prompted a study of the properties of this SLR-active substance reported above. The culture filtrate of *L. arabinosus* grown in presence of xanthine and excess of pABA was found to support growth of *L. citrovorum* (N.C.T.C.) to a greater extent than comparable concentrations of FA.. It also showed a greater differential in activity in overcoming the inhibition of growth of SLR by methyl folic acid (cf.[14]) though, in this respect, it was not as effective as Reticulogen, Lilly[9] and rat's urine[15] when used as CF sources in equivalent FA potencies. That the culture filtrate factor was different from FA was also demonstrated from results on its distribution between *n*-butanol and water at various pH where its properties were intermediate between FA and CF (Reticulogen). Unlike rhizopterin, the filtrate factor supported growth of *Lactobacillus casei* (*cf.*[16]).

Further work on the possible nature of this FA-active substance (s) and on the related enzymes is in progress.

Our thanks are due to the Indian Council of Medical Research under whose auspices this work has been carried out.

Dept. of Chem. Tech., V. B. MITBANDER.
University of Bombay, A. SREENIVASAN.
*March* 10, 1951.

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## THE CONTRACTILE SYSTEM FOR LACTIC TONE IN UNSTRIATED MUSCLE

UNSTRIATED muscle contains two cycles for contraction. In one cycle the energy for contraction is derived from chemical stores; in the other cycle, the energy for contraction is derived from that stored in the structure.[1,2] These two cycles operate upon two different contractile mechanisms respectively.[3-6] The twitch contraction and lactic tone derive energy from the first cycle and the alactic tone from the second.

As expected, therefore, lactic tone is subserved by the same contractile mechanism as the twitch contraction. This is shown by the following observations: (1) The cardio-œsophageal part of the frog's stomach muscle shows predominantly lactic tone and the pyloric part, predominantly alactic tone; the latter can be destroyed by sudden stretch without affecting twitch, and the twitch contraction can be damaged without affecting the alactic tone.[3-6] But if lactic tone in the cardio-œsophageal part is destroyed by sudden stretch, the twitch contraction is damaged (Fig. 1). (2) If during

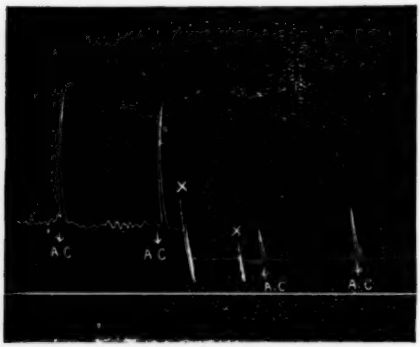


FIG. 1. Frogs' stomach muscle from the cardio-oesophageal part. The muscle is stimulated with alternating current, 10 volts for 10 seconds, every 15 minutes at A.C.; suddenly stretched at ×.

twitch contraction the muscle is given a jerk, then alactic tone is not affected but lactic tone decreases. These experiments are best performed on those muscles which show twitch contraction as well as lactic tone, such as the cardio-œsophageal part of the frog's stomach muscle or the human appendix. In some muscles, the damage caused by stretching is temporary, and there is gradual recovery.

Thus the contractile mechanism for twitch contraction and lactic tone is the same. This probably accounts for the antagonism between tone and twitch. We have not noticed any antagonism between twitch and alactic tone, but have done so between twitch and lactic tone. The latter phenomenon is then, probably due to the fact that they have to compete for the same contractile mechanism.

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*April* 15, 1951.

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## NITROGEN FIXING CAPACITY OF THE DIFFERENT FRACTIONS OF THE SOIL

THE nitrogen fixing capacity[2,3] of the different fractions of the manured and unmanured alluvial soil as affected by continuous cropping has been studied by adding 2·0 gm. of different fractions in 100 c.c. of Fred and Waksman (1938) medium No. 77. The flasks were then inoculated with pure culture of azotobacter and incubated for a fortnight. After incubation these flasks were analysed for their total nitrogen content. The results are incorporated in the following table.

TABLE I

*Nitrogen fixed in presence of different mechanical fractions in mgm. per 100 c.c.*

| Fractions | Manured | | | Unmanured | | |
|---|---|---|---|---|---|---|
| | 0-6″ | 6″-1′ | 1′-2′ | 0-6″ | 6″-1′ | 1′-2′ |
| Clay | 7·35 | 7·80 | 5·35 | 7·29 | 7·92 | 5·49 |
| Silt | 3·86 | 3·44 | 3·09 | 4·63 | 4·42 | 3·72 |
| Sand | 2·05 | 2·11 | 1·55 | 2·32 | 2·97 | 1·97 |
| Sand+Silt | 3·85 | 2·95 | 2·21 | 3·97 | 3·54 | 2·71 |
| Sand+Clay | 4·25 | 3·97 | 3·05 | 5·40 | 4·90 | 4·07 |
| Silt+Clay | 5·97 | 5·67 | 4·52 | 6·98 | 6·03 | 5·21 |
| Sand+Silt+Clay | 4·75 | 3·87 | 3·25 | 5·74 | 4·85 | 4·35 |

It is apparent from these results that the finely divided material has some physiological influence on the fixation of atmospheric nitrogen

by azotobacter. This is in agreement with the observation of McCalla (1938). This increased nitrogen fixation in presence of clay may be attributed to the localization of energy which helps nitrogen fixation. Finer the fraction, greater is the surface exposed for the absorption of the nutrients. It appears that these particles aid in fixation of nitrogen by replenishing ions in the solution when they are removed by the growing organisms.

The clay fraction of the manured and unmanured plot had more or less the same nitrogen-fixing capacity, which is of the order of 7·5 mgm., whereas the silt and sand fractions of the unmanured plot showed a greater nitrogen-fixing capacity as compared to the manured one. This greater nitrogen-fixing capacity of the coarser fractions of the unmanured plot may be one of the reasons of inherent fertility of such land.

The joint effect of these fractions, in the proportion in which they existed in the soil, on the fixation of atmospheric nitrogen showed that such a mixture of the three mechanical fractions fixed greater nitrogen in case of unmanured soil despite the fact that clay individually from both the plots had fixed almost equal nitrogen. The increased physiological efficiency of nitrogen-fixation due to the sand and silt fraction of the unmanured soil appears to be sufficient to shift the balance in favour of the unmanured plot.

Similar investigation is in progress with different species of azotobacter.

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*January* 2, 1951.

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## EFFECT OF CERTAIN HORMONES ON GROWTH AND REPRODUCTION OF SOME SPECIES OF *PHYTOPHTHORA*

THE present work deals with the effect of 2,4-dichlorophenoxyacetic acid, 1-naphthylacetic acid, 3-indolylacetic acid, and γ—3-indolylbutyric acid on the growth and reproduction of the following species of the genus *Phytophthora*: *P. cryptogea* Pethyb., *P. parasitica* Dastur, *P. arecæ* (Colem.) Pethyb., and *P. meadii* McRae. The fungi were grown in 150 c.c. Erlenmeyer Pyrex flasks containing 20 c.c. of the medium which acted as control. It consisted of the same substances as that of the medium used by Leonian.[2] This medium will be referred to as the basal medium. Concentrations of the hormones varying from 1 part in ten thousand to 1 in one million were employed. Each set was run in triplicate. All experiments were performed at room temperature (25-28° C.) and the organisms were exposed to diffuse daylight with intervening dark periods at night, as was done by Cantino.[1] Care was taken that the inoculum was almost equal in each case. *P. cryptogea* and *P. parasitica* did not show any appreciable growth in the basal medium acting as control, while *P. meadii* and *P. arecæ* did grow, but not well, in the same medium, the last named species giving best growth. The addition of hormones to the basal medium even in the lowest concentration tried did not induce any acceleration in growth. On the other hand their higher concentration showed considerable retardation in the growth of the fungi. Addition of 0·05 gm. per litre of yeast extract to the basal medium induced some growth in case of *P. cryptogea* and *P. parasitica*, and much better growth in *P. meadii* and *P. arecæ*. The basal medium containing yeast extract (0·05 gm. per litre) was also supplemented with the hormones singly in concentration 1 part to ten thousand. In these media, even though the yeast extract was present, yet the hormones retarded the growth of the fungi (see Plate I).

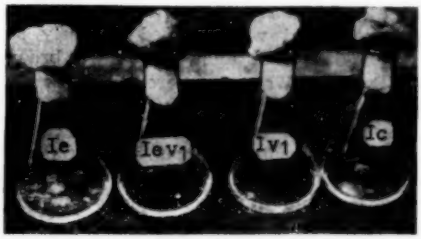


PLATE I

These fungi were also grown in the basal medium supplemented with 0·2 per cent. proteose peptone, a substance which induces growth of the fungi and not their sexual reproduction (Leonian[2]). A number of colonies grown in this solution were thoroughly washed in sterile distilled water and transferred to one set of flasks containing only 20 c.c. of the basal medium, and in another set of flasks containing the basal medium supplemented with 1 part in fifty-thousand of the different growth substan-

ces added singly. A microscopic examination of the colonies after intervals of one and two weeks showed that these hormones do not induce sexual stimulation in the Phytophthoras studied.

It is, therefore, concluded that these growth substances or hormones, which are found to stimulate growth in higher plants, are of no value to the Phytophthoras either as growth stimulants or as sexuality inducing agents. On the other hand, they inhibit the growth of these fungi in higher concentrations. Hence it will be better if these so-called hormones or growth substances are termed 'growth regulating substances', a term more general and self-explanatory.

Grateful thanks are due to Dr. R. K. Saksena for his help in this investigation.

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*September* 15, 1950.

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## A NEW BACTERIAL LEAF SPOT ON *VITIS WOODROWII* STAPF.

A BACTERIAL leaf-spot was noticed on leaves of *V. woodrowii* (locally known as "Girnul") near Ambarnath (Thana) in September, 1949. The pathogen isolated in pure state from leaves produces many circular spots (0·5 to 1·0 mm.) with water-soaked margin along the main and lower side veins. Young spots which look translucent and water-soaked in early stages when held against light, later turn brown to dark-brown. When numerous, two or more spots coalesce forming irregular lesions. The centre of spots is raised; it is rough to the touch due to drying of gummy bacterial exudation. Severe infection results in the production of numerous minute specks mainly towards the base of the leaf.

*Pseudomonas vitis-woodrowii* sp. nov.—Short rods; gram-negative; non-capsulated; motile with a polar flagellum; measure 1·5 × 0·8 $\mu$; not acid fast; nonspore forming; ærobe; gelatin liquefied; starch and casein hydrolysed; litmus reduced; on potato dextrose and nutrient dextrose agars colonies are round, smooth, capitate with entire margins with diameter 1·2 cm. in 7 days, colour pale gull gray (R); slow growth on potato cylinder turning it dark gray; good growth in nutrient broth in 24 hours; acid but no gas in dextrose, lactose and sucrose but no growth in salicin; ammonia and hydrogen sulphide produced; no growth in synthetic asparagin medium; M.R. and V.P. tests negative; Lœffler's blood serum completely liquefied; indol not produced; nitrates not reduced; NaCl tolerant only upto 1%; optimum temperature for growth between 25-28° C.

Pathogenic on leaves of *Vitis woodrowii*, but not on *V. vinifera*.

Detailed account will be published elsewhere.

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*January* 8, 1951.

## FRIES' REARRANGEMENT OF ALIPHATIC ESTERS OF $\beta$-NAPHTHOL

WHILE the Fries' rearrangement has been studied with various esters of $\alpha$-naphthol, in the case of the $\beta$-naphthyl esters this has been reported only for the acetate.[1] We have now extended the reaction to the higher saturated aliphatic esters of $\beta$-naphthol. The reactions were tried in carbon disulphide and tetrachloroethane at higher temperatures, and nitrobenzene for lower temperatures. The first two solvents favoured the exclusive formation of ortho-hydroxy ketones, while low yields of a different product not giving Pyman's test were obtained with nitrobenzene. Eight new ortho-hydroxy ketones have thus been prepared in yields ranging from 60-100%, some of which have been characterised through their 2 : 4-dinitrophenylhydrazones (see table below).

| | Ester | M.p./b.p. | Ketone | M.p./b.p. |
|---|---|---|---|---|
| 1 | 2-Naphthyl propionate | *m.* 46–47° | 1-propionyl-2-naphthol | *m.* 64–66° |
| 2 | 2-Naphthyl butyrate | *m.* 22–23° *b.* 140–45/23 m. | 1-butyryl-2-naphthol | *m.* 41–42° |
| 3 | 2-Naphthyl isobutyrate | *m* 42–42·5° | 1-isobutyryl-2-naphthol | *m.* 106–08° |
| 4 | 2-Naphthyl caproate | *b.* 200–05°/15mm. | 1-caproyl-2-naphthol | *b.* 205–10°/5 mm. |
| 5 | 2-Naphthyl caprylate | *m.* 37–37·5° | 1-octanoyl-2-naphthol | *m.* 81° (sodium salt) |
| 6 | 2-Naphthyl caprate | *m.* 52·5–53·5° | 1-decanoyl 2-naphthol | *b.* 252-58°/12 mm. |
| 7 | 2-Naphthyl laurate | *m.* 54–55° | 1-lauryl-2 naphthol | *m.* 32–33 *b.* 280–85°/5 mm. |
| 8 | 2-Naphthyl myristate | *m.* 65–66° | 1-myristyl-2-naphthol | *m.* 46–47° |

This rearrangement is also being studied with the aromatic and unsaturated aliphatic esters of β-naphthol. Fuller details will be published later.

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*January* 15, 1951.

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## ON A NEW TYPE OF ANOMALOUS SECONDARY GROWTH FOUND IN THE STEM OF *VITIS QUADRANGULARIS* WALL.

THE stem is jointed and the internodes are 4-winged. In the region of the node the girdle of vascular bundles is circular and all the bundles are similar in size. The cambial activity is regular, and of the *Aristolochia* type.

In the region of the internodes, the girdle of vascular bundles is quadrangular, the bundles being separated by large medullary rays. Those that lie near the wings are much bigger. Cambial activity starts very early, but is prominent only in the region of the wings, so that, after a year or so, these bundles appear much wider, longer and larger in number due to proliferation (as mentioned for *Cissus sulcicaulis* by Solereder 1908), than those opposite the grooves. The angularity of the wing-region gradually disappears.

This irregularity continues, the activity of the bundles of the grooves being nominal, so that after the lapse of 4 to 5 years, the stem seems to be made up of four separate strands of wood, as in *Serjania ichthyoctona* (Eames and MacDaniels 1947), twisted slightly like a rope, and bound at the nodes. The intermediate groove region even disorganises, and leaves these four strands apart.

This type of anomalous secondary growth, combining the conditions found in *Serjania ichthyoctona* and *Aristolochia triangularis* (Eames and MacDaniels 1947) has not been recorded before.

Science College, J. G. SRIVASTAVA.
Patna,
*December* 18, 1950.

Solereder, *Systematic Anatomy of Dicotyledons* (English Translation), 1908. Eames and MacDaniels, *An Introduction to Plant Anatomy* (1947 edition).

## ON AERIAL ROOTS IN VITIS *QUADRANGULARIS* WALL.

THE occurrence of aerial roots in vitis has been reported by Small (1913), Hedrick (1922), Bailey (1925), and Turner (1934) for *Vitis rotundifolia*, and by Moore (1933) for an unnamed conservatory species. Of the 75 or more species of vitis in India (Hooker, 1872), of which 17 occur in Bihar alone (Haines 1921), not one including the species described here, has been known to produce aerial roots. Only *V. obtecta* has its older creeping stems covered with short aerial roots (Hooker).

In *Vitis quadrangularis*, aerial roots are given out mostly in the rainy season by horizontal, as well as by oblique and vertical branches, by young as well as old stems. The aerial roots originate singly, rarely in twos, at the nodes usually by one of the sides in between the ones producing the leaf and the tendril irrespective of its orientation.

They originate from the pericycle in between the vascular bundles, or from secondary medullary rays if secondary growth has started, and not from the secondary phlœm as is the usual condition (Eames and MacDaniels 1947).

The roots, as in *Tinospora cordifolia*, hang vertically down for 8-12 feet, till they touch the ground and as soon as they have done so they enter it and branch profusely, the branches running in all directions.

The roots are white at the tip, pinkish or greenish in older parts, soft and brittle and about 1/10″ in diameter. As soon as the earth is pierced in, the roots start thickening till they are 1/3″ or more in diameter, hard and tough.

The roots do not branch unless the tip is injured, when one or two side-branches are produced. The development of profuse underground roots on touching the soil is perhaps due to this type of injury, which is very likely, as there is no root cap.

None of the aerial roots dies at the end of the first season as happens in *V. rotundifolia* (Turner).

Both the aerial and subterranean roots show many root characters. The secondary growth is of the *aristolochia* type.

Science College, J. G. SRIVASTAVA.
Patna,
*December* 18, 1950.

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## INDUCED VARIATION IN THE GERMINATION OF CHLAMYDOSPORES OF *USTILAGO SCITAMINEA*

VARIATIONS from the normal type in the germination of chlomydospores of *Ustilago segetum* have been recorded by Brefeld.[1] Stakman[6] and Hitchcock[4] have also described several types of promycelia in the germination of chlamydospores of *U. zeæ*. Kernkamp and Petty[5] recorded twenty-five different germination types of *U. zeæ* and showed that the tendency towards a given germination type was determined by genetic factors. In *U. scitaminea*, Butler[2] described two different types of germination, one the usual type with a short promycelium divided into two or three cells by transverse walls with sporidia at the tip and laterally near the septa and the other one in which the promycelium grows into a branched hypha.

While studying the action of hydrophobic colloidal sulphur[3] on chlamydospores of *U. scitaminea*, the author observed some interesting deviations from the normal types of germination. Germination of chlamydospores was inhibited on 1 per cent. water agar containing 20 parts per million of the fungicide. On water agar containing 10 ppm. of the fungicide, after 24 hours at 23° C. about 20 per cent. of the germinating spores showed abnormal germination. In such abnormally germinating spores 16 different germination types could be observed. The most interesting one was that in which all the four sporidia were borne at the tip of the promycelium. This type constituted about 5 per cent. of the abnormally germinating spores and resembled the usual "Tilletia type" germination in that the sporidia were borne at the tip of a non-septate promycelium. In another type the promycelium was suppressed completely and the sporidia were borne directly on the spore (Fig. 1). This

FIG. 1. Induced variations in the germination of Chlamydospores of *Ustilago scitaminea* × 270.

type constituted about 3 per cent. of the abnormally germinating spores. The other types differed from each other in the types of promycelia, the number of sporidia borne on the promycelium and the formation of buckle joints. This deviation in the germination of the spores is almost certainly due to the action of hydrophobic colloidal sulphur and not to the differences in genetic constitution of the spores, as in control plates all spores showed normal germination.

It, therefore, appears that, at least in sugarcane smut, the germination type of chlamydospores could be changed profoundly as a result of the action of hydrophobic colloidal sulphur.

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*January* 10, 1951.

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## NOCl AS A DIAZOTISING REAGENT

IT was expected that NOCl should be a rich source of $NO^+$ and hence should act as an effective diazotising reagent. Our results have fulfilled these expectations. The diazotisation of the amine is quick and quantitative.

The NOCl was obtained in two different ways: (*i*) by the action of $PCl_5$ on $NaNO_2$; (*ii*) by Rupe's method.[1] The diazotisation was effected by passing the NOCl into the amine under the following conditions: (*a*) In presence of acetic acid. (*b*) In presence of water. (*c*) In the absence of any medium. The amines used were aniline, α-naphthylamine, β-naphthylamine and the R.C. base. The temperature maintained was in the range 0 to 8° C.

A full paper describing the work in detail is being sent for publication.

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*February* 14, 1951.

1. *Hel. Chem. Acta*, 1921, **4**, 149.

## OBSERVATION ON THE DISEASES OF TEZPATA

THERE has been little attempt to study the pathogens of tezpata (*Cinnamomum tamala*) much used as aromatic ingredient and spice in cooking all over the world. Tezpata leaf suffers from various diseases caused by insects and fungi as well.

Many of the leaves form a large number of small galls which are mainly caused by insect-bite. Small insects lay eggs in the spongy cells, which, on stimulation, bulge out on the upper surface of the leaf, distorting it with galls and damaging it.

Shot holes and leaf-spot diseases are not uncommon. So far two species (*Pestalozzia cinnamomi* and *Cercospora* Sp. of *Fungi imperfecti* have been found to cause the diseases when plants are grown in shade and crowded condition.

Spore fruits of *Pestalozzia cinnamomi*, when mature, emerge as black pointed tips on the lower surface of the diseased leaf, as seen macroscopically. In the host tissue, the hyphæ are interwined into a stromatic layer forming a saucer-shaped cavity, within which thousands of conidia are borne directly on the stromatic layer. Conidium is fusiform 5-celled, golden brown except the basal and apical cells; the latter is terminated by 3 stiff hairs. Conidium is 27 microns × 8 microns in size.

Spots caused by *Cercospora* Sp. are dark-brown and zonate. Conidiophores which develop from the superficial felty growth of the mycelium are septate and wavy. Conidium is hyaline to faintly yellowish, 4 to rarely 5-celled, elongated spindle shaped, with rounded apex and somewhat acute base, 52 $\mu$ × 5·5 $\mu$ in size. Mycelium and conidiophore are septate, thick-walled, dark brown 3·5 $\mu$ in thickness.

Comparative study of the specific characters and other aspects of the pathogens will be published elsewhere.

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*February* 28, 1951.

## *SORGHUM VERSICOLOR*, ANDERSS—A SPECIES HIGHLY RESISTANT TO *STRIGA*

THE phanerogamic root parasite *Striga* is represented in India by four species, *viz.*, *Striga lutea*, Lour., *S. densiflora*, Benth., *S. euphrasioides*, Benth. and *S. orobanchioides*, Benth. Since 1933, the Economic Botanist to the Government of Bombay has been breeding *Striga* resistant varieties using the local and exotic *Jowar* types like *Bilichigan*, *Mudinandyal* and *Bonganhilo*, which are fairly resistant to *Striga lutea*. The last one from Tanganyika is, in addition, fairly resistant to *Striga densiflora*.

With a view to explore additional sources for resistance, a collection of 35 *Sorghum* species and varieties of *Sorghum vulgare*, Pers., was subjected to an artificial infection of *Striga*. These types, with a susceptible local variety as control, were sown in earthen pots in the open, in triplicate. They were sown with a seed mixture of virulent ecotypes of *Striga lutea* (from Mundargi, Dharwar District) and *Striga densiflora* (from Indi, Bijapur District). Most of the *Sorghum* types showed varying degrees of infection except *Sorghum versicolor*, Anderss. (accession number 159), *Sorghum conspicuum*, Snowden and *Sorghum vulgare*, Pers. var. Atlas Sorgo.

These three *Sorghum* types were subjected to a second rigorous test along with the susceptible control in a glass house, where the prevailing humidity and temperature provided a near approach to the optimum conditions favouring *Striga* infection. *Sorghum versicolor* did not show any infection in any of the five replications during the entire period of growth. *Sorghum conspicuum* and Atlas Sorgo were considerably more resistant than the control but their resistance failed during the later stages of growth.

A third test was conducted on the above three *Sorghum* types along with the existing resistant type *Bonganhilo* and a local susceptible type *Maldandi* as controls. There were seven replications with seven pots in each replication and a mixture of all the available ecotypes of *Striga lutea* and *Striga densiflora* was used for artificial infection in two heavy doses, one at sowing time and another during the preflowering stage. The results are summarised below (see Table I).

It is seen that none of the plants of *Sorghum versicolor* was affected by *Striga*. In the case of *Sorghum conspicuum*, out of 24 plants affected, the parasite belonged to *Striga lutea* and none to *Striga densiflora* to which it appears to be resistant. In the case of Atlas Sorgo, the

1. Butler, E. J. and Bisby, G. R., *Scientific Monograph*, 1931, No. 1. 2. Mundkur B. B., *Ibid.*, 1938, No. 12. 3. Butler, E. J., and Jones S. G., *Plant Pathology*, 1949. 4. Chaudhury, S., *Journal of Indian Botanical Society for August* 1946.

TABLE I

| Name of the type | Number of seeds | | Number of plants affected | Percentage of host plants affected |
|---|---|---|---|---|
| | Sown | Germinated | | |
| *Sorghum versicolor* .. | 49 | 38 | nil | 0% |
| *Sorghum conspicuum* .. | 49 | 44 | 24 | 54·5% |
| *S. vulgare*, var. Atlas sorgo .. | 49 | 39 | 24 | 61·5% |
| *S. vulgare* var. *Bonganhilo* .. | 49 | 49 | 11 | 22·4% |
| *S. vulgare* var. *Maldandi* .. | 49 | 48 | 33 | 68·7% |

affected plants showed 80 per cent. *Striga lutea* and the rest *Striga densiflora*.

An additional 28 *Sorghum* species and varieties were received later, and subjected to a preliminary experiment with five pots for each type similarly subjected to artificial infection of *Striga*. In this experiment, *Sorghum purpureosericeum*, Sch. and Asch., and *Sorghum nitidum*, Pers. did not show any infection whereas all other *Sorghums* were affected by *Striga*.

*Sorghum versicolor* which proved to be highly resistant in three successive trials as also *Sorghum purpureosericeum* and *Sorghum nitidum* which tentatively show indications of being rtsistant to *Striga*, all belong to the section *Para-Sorghums* (beared nodes and simple panicle branches). They have $2n = 10$ chromosomes as compared to *Sorghum vulgare* which has $2n = 20$ chromosomes and belongs to the section *Eu-Sorghums*. In the light of the above observations, *Para-Sorghums* may prove to be of considerable importance in evolving varieties of *Sorghums* resistant to *Striga*. However, in view of the known difficulties in their hybridisation and their different chromosome numbers, it would require an elaborate cytogenetic technique in order to effect the transfer of desirable characters from *Para-Sorghums* to the cultivated *Sorghums*.

I am indebted to Prof. L. S. S. Kumar for the guidance. I am thankful to Shri. M. V. Gadre for the help rendered and to Shri. J. G. Oke, Shri. A. V. Gokhale and Shri. V. R. Karmarkar for conducting the confirmatory trials. Seeds of *Sorghum versicolor* were supplied by Dr. David J. Ward of United States Department of Agriculture, and of *Sorghum nitidum* by Dr. William Hartley of the Division of Plant Industry, Australia. The seeds of *Sorghum purpureosericeum* were collected around Poona by Dr. Solomon and the author.

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## THE DISTRIBUTION OF VITAMIN C IN SOME COMMON GASTROPODS AND ITS BIOSYNTHESIS IN *PILA VIRENS LAMARCK* (MOLLUSCA-GASTROPODA)

BOURNE[1] has stated that little information is available on the vitamin C content of the eggs and early embryos of various animals. Here is reported a study of the distribution of vitamin C in some gastropods and also in the ontogeny of one of them, *Pila virens*.

In the adult stage of *Pila*, vitamin C can be recognised in the connective tissues of different organs, salivary glands, œsophagus, stomach, intestine, testis and the digestive gland, which on titrinutric estimation with 2,6-dichlorophenol indephenol, was found to contain a relatively larger amount (19·9 mgm. per 100 gm. of the tissue), a value which compares favourably with that of some plants.

The distribution of vitamin C was also studied in *Viviparus*, *Achatina*, *Oliva*, *Turritella* and a few other gastropods, both freshwater and marine. In *Viviparus* the distribution of vitamin C in the digestive gland is similar to that found in *Pila*. *Achatina* shows an interesting distribution of vitamin C as it is intracellular, being concentrated towards the distal ends of the cells of the digestive gland. The digestive glands of *Oliva* and *Turritella* show a similar distribution.

The distribution of vitamin C in the ontogeny of *Pila virens* presents interesting features. The embryonic stages and the juvenile stages till about the tenth day after hatching, whether fed on their natural diet or starved, do not show any trace of vitamin C. Some of the juvenile stages were also fed on fruits rich in vitamin C like oranges, but failed to show any trace of vitamin C.

The absence of vitamin C in young animals and its appearance in later stages suggests the possibility of biosynthesis of vitamin C in the tissues of *Pila*. Experiments were devised to determine the stage at which vitamin C gets synthesised in the animal. Young specimens which were fed, some on boiled rice, and some on filter-paper for a fortnight from the time of hatching, showed the first traces of vitamin C on the twelfth day, and on the four-

teenth day most of the specimens that were examined showed vitamin C. Control experiments were set up in which the specimens were starved for the same duration, and there was no trace of vitamin C in them. A few of the starved ones were separated on the thirteenth day and fed, some on boiled rice and some on glucose, for twenty-four hours. Those fed on glucose showed vitamin C, but those fed on boiled rice showed only traces of it. It is evident that vitamin C is synthesised in the tissues of *Pila virens* more readily from glucose.

The synthesis of vitamin C in animal tissues has been known so far to occur in the rat, the rabbit, and the chick. The synthesis of vitamin C in *Pila* is therefore of interest.

My thanks are due to Dr. A. Sreenivasan, Bombay, and Dr. Sarma, Madras University, for some references, and to Prof. R. V. Seshaiya for guidance.

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Annamalainagar,
*March* 10, 1951.

Bourne, G., *Cytology and Cell Physiology*, 1942.

## THE PERITHECIAL STAGE OF *ERYSIPHE POLYGONI* DC. ON PEA (*PISUM SATIVUM* LINN.)

The perithecial stage of the powdery mildew, *Erysiphe polygoni* DC. was observed on 26th July 1950, on the leaves of pea (*Pisum sativum* L.), cultivated in fields near Bangalore. The crop was about three months old and in pods. The rainfall in July ranging from a trace to 63 cents per day was fairly well distributed throughout the month except for short breaks on the 9th, 10th, 18th and 19th. The week just prior to the observation received continuous rainfall varying from 2 to 38 cents per day. The highest maximum and the lowest minimum temperatures during the period two weeks prior to the observation was 82·4° F. and 63·8° F. respectively, and those for the two subsequent weeks were 84·5° F. and 64·8° F. respectively. The relative humidity ranged from 76 to 95 per cent. during July.

The perfect stage of *Erysiphe polygoni* is of rare occurrence in India. Butler and Bisby[2] record the occurrence of the parasite on *Pisum sativum* in Dehra Dun, Pusa, Verinag, Kashmir and Maymyo. Most of their perithecial collections originated in the north either in hills or the Indo-Gangetic plain where there is a distinct cold season. Butler[3] describes in detail the perithecia on peas. His measurements are apparently taken from Salmon. Uppal, Patel and Kamat[4] state that the conidial stage is the only one found.

The perithecia were observed by the writer on some of the severely infected leaves on the plant as black bodies, scattered in small groups on the white floury patches. They were present on both the surfaces of the leaf. They are small, round and orange to brown coloured turning dark-brown to black later. They consist of distinct polygonal cells and possess 24 to 46 long, simple, sparsely septate, free and spreading appendages. The appendages are brownish in colour and measure 79 to 174 $\mu$ in length. The asci are limited in number, one or two in a perithecium. They are globular or ovate, almost sessile and hyaline. Four to six ascospores are observed in an ascus. The ascospores are hyaline, ovate, and single-celled. The measurements of the reproductive structures observed by the writer in Mysore (South India) correspond as shown in the following table to those of the Central European species of Blumer as given by Bremer, *et al.*[1] rather than those given by Butler.[3]

Table I

| | | Butler (apparently from Salmon) | Blumer's mid-European strain of *Erysiphe pisi* as given by Bremer, *et al.* | Mysore (N.S.V.) |
|---|---|---|---|---|
| 1 | Perithecia .. | 90$\mu$ | 85–126$\mu$ | 95–134·5$\mu$ |
| 2 | Ascus No. . | 2-8 | .. | 1–2 |
| | ,, Size .. | 46–72 $\mu$×30–45 $\mu$ | 50–60 $\mu$×30–40 $\mu$ | 31·5–63 $\mu$×31·5–39·5 $\mu$ |
| 3 | Ascospores No. .. | 3-8 | .. | 4–6 |
| | ,, Size | 19–25 $\mu$×9–14 $\mu$ | 22–27 $\mu$×13–16 $\mu$ | 16–24 $\mu$×8–16 $\mu$ |

I am thankful to Sri. S. V. Venkatarayan, Plant Pathologist, for kind encouragement and helpful suggestions in the course of this work.

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*December* 1, 1950.

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## A PALM FRUIT FROM KAPURDI (JODHPUR, RAJASTHAN DESERT) *COCOS SAHNII* Sp. Nov.

DURING my survey work of Western Rajasthan, I investigated a collection of fossil impressions on Fuller's Earth taken out from the mines at Kapurdi, known for its early tertiary (Eocene) remains. One of the impressions came out to be *Cocos* species (see Photograph). The full description will be given elsewhere. I have named it after the late Prof. B. Sahni. It is worthy of note that the fossil stem *Palmoxylon Sundaram* Sahni from Sagaur (C.P.), was identified by me in 1938 as a *Cocos* stem and was accepted by Prof. Sahni as such. This discovery of fruit confirms my view that *Cocos* was known in India in early tertiaries.

FIG. 1. Remains of the endocarp of *Cocos sahnii* showing the two eye like depressions at one end. × 1.

Herbarium, K. N. KAUL.
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## CYTOPLASMIC INHERITANCE IN *SACCHARUM*

THE theory of the "plastogene"[1] recognises the existence of determinants outside the nucleus attached to the plastids having all the properties of nuclear genes including permanence. The existence of another set of extra nuclear determinants "plasmagene"[2] is vouched for by non-mendelian inheritance of which reciprocal differences are the simplest evidence. Breeding results in reciprocal hybrids in *Linum*,[3,4] *Nicotiana*[5] and *Zea*[6] have indicated that certain characters, especially male sterility, are determined at least in part by some condition of the cytoplasm.

Interspecific hybrids in Saccharum are not usually identical reciprocally. The species involved are *S. officinarum*, *S. spontaneum*, *S. barberi* and *S. robustum*. The gross appearance especially in respect of habit and thickness of stem, of reciprocal crosses, in some cases is so glaringly maternal that it sets one thinking if it could not be a case of cytoplasmic inheritance, at least in part in the sense that it could be a case of interaction between genes and cytoplasm. The problem is rendered more interesting in view of the fact that interspecific hybridization in Saccharum does not always involve the union of the haploid parental genomes. If inheritance was purely genic one would expect the hybrid to resemble that parent which had contributed the larger number of chromosomes. In some instances even though the male parent contributed the 2*n* number, the resemblance of the hybrid is more to the maternal parent which contributed the usual haploid number. In some crosses the egg is known to contribute neither its haploid nor its diploid number. The various crosses and reciprocal crosses with their relevant chromosome numbers are given in brief in Table I. The general configuration of the hybrid appears to be influenced greatly by the cytoplasm of the egg parent. However, it is not suggested that this phenomenon is universal among all the varieties of Saccharum species. For instance, while it is marked when the varieties like Chittan and striped Mauritius are used, it is not so pronounced when others like Kaludai Boothan or Black Cheribon are involved. It may well be that this phenomenon of cytoplasmic inheritance is confined only to some varieties.

Support to the view of the existence of cytoplasmic inheritance is to be found in the manifestation of maternal inheritance with regard to the phenomenon of male sterility. Dutt and Krishnaswami[7] and Dutt and Rao[8] have recorded this phenomenon in some spontaneum hybrids. An analysis of the available hybrids suggested that this phenomenon revealed itself only when *S. spontaneum* was involved in the

TABLE I

| No. | Parents and their haploid chromosome number: Female | | Male | | Hybrids: Chromosome No. and how derived | Gross appearance (Habit and thickness of stem) |
|---|---|---|---|---|---|---|
| 1 | A. *S. officinarum* (K. Boothan) | 40 | *S. spontaneum* (Coimbatore) | 32 | 112 $(2n+n)$ | Like *officinarum* |
| | B. *S. spontaneum* | 32 | *S. officinarum* (K. Boothan) | 40 | 112 $(n+2n)$ | Like *officinarum* |
| | C. *S. officinarum* (Chittan) | 40 | *S. spontaneum* | 32 | $2n$=112 $(2n+n)$ | Like *officinarum* |
| | D. *S. spontaneum* | 32 | *S. officinarum* (Chittan) | 40 | $2n$=112 $(n+2n)$ | Like *spontaneum* |
| 2 | A. *S. officinarum* | 40 | *S. robustum* | 36 | $2n$= 76 $(n+n)$ | Intermediate |
| | B. *S. robustum* | 36 | *S. officinarum* | 40 | $2n$= 76 $(n+n)$ | Intermediate |
| 3 | A. *S. robustum* | 36 | *S. barberi* | 46 | $2n$= 82 $(n+n)$ | Like *S. robustum* |
| | B. *S. barberi* | 46 | *S. robustum* | 36 | $2n$= 82 $(n+n)$ | Like *barberi* |
| 4 | A. *S. barberi* | 46 | *S. spontaneum* | 32 | $2n$= 78 $(n+n)$ | Like *barberi* |
| | B. *S. spontaneum* | 32 | *S. barberi* | 46 | $2n$= 78 $(n+n)$ | Like *S. spontaneum* |
| 5 | A. *S. barberi* | 46 | *S. officinarum* | 40 | $2n$=86 $n+n$) | Like *S. barberi* |
| | B. *S. officinarum* | 40 | *S. barberi* | 46 | $2n$=126 $(2n+n)$ | Like *S. officinarum* |

cross as the pistil parent. To clarify this point a number of crosses, reciprocal crosses and back crosses were studied, the results of which are briefly indicated in Table II, especially with reference to this particular character of male sterility.

TABLE II

| Parents: Female | Parents: Male | Hybrid Diploid number and how derived | Male Sterility present − absent + |
|---|---|---|---|
| *officinarum* | *spontaneum* | 112 $(2n+n)$ | − |
| *spontaneum* | *officinarum* | 112 $(n+2n)$ | + |
| *barberi* | *spontaneum* | 78 $(n+n)$ | − |
| *spontaneum* | *barberi* | 78 $(n+n)$ | + |
| **spontaneum* | *sclerostachya* | 79 $(2n+n)$ | + |
| **spontaneum* | *narenga* | 79 $(2n+n)$ | + |
| **spontaneum* | *erianthus* | 84 $(2n+n)$ | + |
| **spontaneum* | *sorghum durra* | 74 $(2n+n)$ | + |

* Reciprocal crosses of these have just been made and in such of those as in which seedlings result, the expectation is that there will be no male sterility. But the presence of this feature in all these crosses involving *Spontaneum* as the mother is worth noting. The possibility of male sterility being due to the intergeneric nature of the cross must not also be overlooked. But in one known intergeneric cross not involving *Spontaneum* as the pistil parent, the phenomenon has not been seen, *i.e.*, *Officinarum* × *Sclero stachya* $(2n + n)$.

The crossing results obtained so far lead one to the following tentative conclusions:—The difference in inheritance is due to a dissimilarity in the cytoplasm of *Spontaneum* on the one hand and the other forms involved on the other, like *Officinarum*, *Barberi*, etc. Individuals of the $F_1$ and later generations, both $F_2$ and back-crosses, resulting from the cros between *Spontaneum* as the female and the others as the male parents, would have cytoplasm contributed by *Spontaneum* whereas the progeny of the reciprocal crosses would have the cytoplasm of the other respective parents. A particular gene or group of genes or even a whole chromosome for bisexuality from *Spontaneum* and *Officinarum* would appear to react normally in their respective cytoplasm. A certain combination of factors seems to produce different phenotypic effects depending upon the derivation of the cytoplasm. When the genes are in a heterozygous condition in *Spontaneum* cytoplasm male sterility is the consequence. If present in that condition, say in *Officinarum* cytoplasm as when *Officinarum* is used as the pistil parent, there is no male sterility. Nor is there an expression of this feature when the genes are in a homozygous condition in *Spontaneum* cytoplasm as in the selfed diploid derivatives of *Spontaneum* or as when *Officinarum* genes come to be implanted in *Spontaneum* cytoplasm by successive back-crossing of *Spontaneum* by *Officinarum*. In other words, the nuclear genes of *Officinarum* and *Spontaneum* are reacting with the plasma-genes of the latter resulting in this defect. A study of the available selfed and back-crossed progeny of the $F_1$'s seems to support the view presented above. In two seedlings of the back-crossed progeny *Spontaneum* × *Sclerostachya* × *Sclerostachya*, the phenomenon is present in

one and absent in the other, which is according to expectation. Because if it were purely cytoplasmic as in Wettstein's Funaria, all the back-crossed progeny would show this feature. Since however, it is believed to be a result of the reaction between nuclear genes and cytoplasm, only in those in which the former are in a heterozygous condition in *Spontaneum* cytoplasm, does the phenomenon of male sterility manifest itself. Hence the expectation in the back-crossed progeny is 1 : 1. However, since these are selected seedlings, we have no idea of the large number that would have been rejected in the nursery. That in any case it is cytoplasmic, can be inferred in a negative way by the complete non-occurrence of male sterility in *Officinarum* × *Spontaneum* × *Officinarum* as also in *Officinarum* × *Spontaneum* selfs, because in both cases the concerned nuclear genes though heterozygous (in half the progenies) are in *Officinarum* cytoplasm whereas in the $F_2$ of what in essence are reciprocal crosses in the sense that *Spontaneum* is the female (*e.g.*, *Spontaneum* × *Sclerostachya* and *Spontaneum* × *Narenga*; though pollen sterile, a few grains are sometimes available in the $F_1$'s to take them to $F_2$'s) the phenomenon is present in the few selected seedlings that are available, since it is in *Spontaneum* cytoplasm that the genes are associated in a heterozygous condition. However, if the entire $F_2$ population is examined the expectation is that half the number would show this feature, the other half being bisexual. It thus appears that nuclear genes and plasmagenes fit one another in heredity in certain ancestral combinations, but fail to do so in certain recombinations produced by crossing. The most common expression of this failure is male sterility. We cannot, however, count upon either absolute constancy or absolute matrilinear descent, as sorting out of the plasmagenes and contamination by pollen cannot be ruled out altogether.

If the cytoplasm of *Spontaneum* is so distinct from that of the other forms as to change the phenotypic expression of the genes for bisexuality, it may be expected to have at least some effect on the expression of all the other genes. This seems to be the case at least in some cases as for instance in *Spontaneum* × *Barberi*; *Spontaneum* × *Officinarum*, where there are reciprocal differences as regards habit, stature and thickness of stem, in addition to male sterility. However, only where *Spontaneum* is involved is there the expression of male sterility. In some crosses not involving *Spontaneum*, the reciprocal differences are confined to other characters than male sterility, *e.g.*, *Barberi* × *Officinarum*. This would be comparable to the case of tomato[9] where the difference is one of size and expressing itself in $F_1$ and in the segregating $F_2$. It is also conceivable that male sterility alone is the outward expression of this interaction, unassociated with other differences of size and habit, in reciprocal crosses. It may then be that the action of all the genes is affected only in respect of that character while in regard to other characters their action is presumably unchanged.

Further experimental work is in progress. The evidence available at present cannot by any means be said to be conclusive. Further studies that are in progress may or may not substantiate the interpretation herein presented tentatively.

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Sugarcane Breeding Station,
Coimbatore,
*December*, 1950.

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## 1851 EXHIBITION SCHOLARSHIP

THE Royal Commissioners for the Exhibition of 1851, London, have awarded the Science Research Scholarship for the year 1951 to Shri. Kamla Kant Pandey, Research Scholar at the Indian Agricultural Research Institute, New Delhi.

# REVIEWS

**Conductimetric Analysis at Radio-Frequency.** By G. G. Blake. (Publisher: Chapman and Hall). Pp. 109. Price 15 *sh.*

The author has described in this book a new method of radio-frequency analysis which may be used for analysis and titration of solutions, for studies in diffusion and the rate of progress of chemical reactions in solutions. The method consists in setting up a high-frequency oscillator with proper shielding, the plate current being measured by zero-shunted micro-ammeter, and the lead carrying the radio-frequency output from a coupling condenser being attached to a metal sheath or a spiral enclosing a thin pyrex glass tube which contains the solution under study. Variations in experimental method have been suggested to suit different types of analytical work.

It is found that the plate current through the zero-shunted micro-ammeter depends on the concentration of electrolytes in the solution. Hence such concentrations can be estimated, if necessary, by using previously determined calibration curves.

The experimental arrangement is simple and deserves to be tested in physico-chemical laboratories where it is intended to simplify and lighten the work of the analytical chemist.

J. C. G.

**Products and Processes: India's Natural Resources and Their Use in Industry.** By G. R. Kelkar and M. S. Varde. (Published by MacMillan and Co., Ltd., MacMillan Building, 276, Hornby Road, Bombay). Pp. 121. Price Rs. 1-10-0.

The book under review is a welcome departure in this field. The subject-matter of the eight different chapters (Common Salt, Hides, Oilseeds, Minerals, Fertilisers, Rubber, Hides, Skins and Bones, and Shellac) has been well chosen even though one feels that there are other products which are equally important to India and which might have found a place in the book. This would perhaps increase the size of the book, which is confined to 121 pages and priced at the moderate figure of Rs. 1-10-0. One can only hope that a second volume will soon follow the present excellent production relating to other important products in which India holds a prominent position, such as (*a*) manufacture of jute products; (*b*) tea; (*c*) sandalwood oil; (*d*) cashewnuts and others.

Also, it would be of value to mention India's deficiency in important minerals containing tin, lead, zinc, sulphur, silver, graphite, nickel, tungsten, molybdenum, etc.

We are sure that the facts and figures mentioned in the text will be made up to date and various inaccuracies such as the solubility of oil in alcohol, etc., be corrected in a future edition. We welcome this book and recommend it to the general average reader.

S. G. Sastry.

**The Actinomyces—Their Nature, Occurrence, Activities and Importance.** By Selman A. Waksman. (Chronica Botanica Co., Waltham, Mass., U.S.A.), 1950. Pp. xviii + 230. Price $5·00.

Actinomyces, a group of widely distributed and a much neglected group of micro-organisms, have formed the subject of patient, thorough and intensive studies for over three decades, principally, by Waksman and his school. These studies demonstrated the importance of their role in Nature's cycles of carbon and nitrogen. Among this group are to be found causative agents of disease, spoilage and deterioration, sources of enzymes and vitamins and in recent years, of powerful antibiotics which have been responsible for a deeper awakening of the interest shown by scientific investigators in this field.

This volume is a timely contribution by a celebrated worker whose life-long and active association with these organisms, entitles him to write on this subject with singular authority. In a series of well-planned twelve chapters, the author deals with the taxanomical, morphological, metabolic and other aspects of these organisms. The fourth chapter on variations and mutations among them, is worthy of close study. The seventh chapter on the antagonistic properties of actinomyces and production of antibiotics is one which will be eagerly read by all biochemists since it gives a first-hand, living and vivid account of the discovery and production of antibiotics. This is a volume which will be eagerly welcomed by everyone interested in actinomyces and antibiotics.

**Newer Methods of Preparative Organic Chemistry.** Translated and revised from the German. (Interscience Publishers, Inc., New York), 1948. Pp. xiii + 657. Price $8·50.

Pre-war Germany had occupied a pre-eminent position in the field of organic chemistry because of her substantial contributions to, and spectacular achievements in, this branch of science. Under the stress of the World War II, many new advances in methods of preparative organic chemistry were made and these, which were first published in 1940, were brought out in the form of a book in 1942. A second edition of this was issued in 1944 but on account of the war then in progress, none of these editions were available to the rest of the world's laboratories.

The credit of making these valuable articles readily available to the English-speaking chemists, belongs to the enterprising Interscience Publishers, Inc., under whose auspices, a group of American scientists have translated and "contributed substantially to an improvement and adaptation of the original German text".

The subjects dealt with in the volumes are, (1) Oxidations with lead tetraacetate and periodic acid; (2) Dehydrogenation with sulphur, selenium, and platinum metals; (3) Reduction with Raney Nickel Catalysts; (4) Hydrogenation with copper chromite catalysts; (5) Meerwein–Ponndorf reduction and Oppenauer oxidation; (6) The use of biochemical oxidations and reductions for preparative purposes; (7) Substitution reactions of aliphatic compounds; (8) Organic fluorine compounds; (9) Catalysts of organic reactions by Boron fluoride; (10) Use of hydrogen fluoride in organic reactions; (11) Methods for the thiocyanation of organic compounds; (12) The Diene synthesis; (13) Syntheses with diazomethane; and (14) Syntheses with Organolithium compounds.

The fundamental principles underlying each of these organic reactions are discussed and their appropriate applications in the preparation of organic chemicals and also in the elucidation of their structure, are indicated. Suitable examples are given.

This modestly priced and neatly got-up volume will be found indispensable to every organic chemist.

**Progress in Chromatography, 1938–47.** By Prof. L. Zechmeister. (Chapman & Hall, Ltd., London), 1950. Pp. xviii + 388. Price 45 *sh.* net.

The volume under review represents a companion volume to the author's previous treatise on the *Principles and Practice of Chromatography*, and gives a comprehensive bibliographical survey of the widely scattered and difficultly available contributions to the rapidly developing field of chromatography during the last decade.

Twenty-three chapters cover every aspect of the subject; the general section deals with the principles and the methods, while the chapters in the special section are devoted to a consideration of the progress made in the chromatography of important groups of naturally occurring compounds, *viz.*, chlorophylls, porphyrins, bile pigments, carotinoids, miscellaneous natural pigments, lipoids, carbohydrates, amino acids and peptides, sterols, alkaloids, hormones, enzymes, vitamins, antibiotics and other biological principles. Advances in the applied aspects of chromatography are described in the 22nd chapter while the last chapter deals with inorganic chromatography. There are also chapters which deal with organic chemicals including synthetic dyestuffs.

This simple, elegant but nevertheless, versatile and effective technique of chromatography is being extensively and successfully employed in almost every branch of pure and applied chemistry and hundreds of papers are appearing in scientific journals every year. The author has accomplished the difficult task of collecting and classifying the literature in a single volume, documented with references to literature. The volume will be gratefully welcomed by the very large and ever-increasing number of investigators who have adopted this technique as a useful and powerful tool in their experimental armoury. A decennial publication of such volumes in future will serve not only in taking stock of the literature, but also in stimulating further progress in this field.

**Calculating Instruments and Machines.** By D. R. Hartree. I Eng. Edn. (Cambridge University Press), 1950. Pp. ix + 138. Price 12 *sh.*

This is an almost exact reproduction of the first edition published in U.S.A., containing an account of a series of lectures given by the author at the University of Illinois in 1948. The book deals more with the principles of the various instruments rather than with the details of construction of any particular one. In fact, only selected topics have been discussed, namely, those about which the author has first-hand experience. Perhaps the most instructive chapters are those on the differential analyser. But the one on other instruments such as those for

solving algebraic equations, making Fourier synthesis, etc., gives very little information and leaves one unsatisfied. The digital machines, both mechanical and electronic, are treated particularly well and Prof. Hartree has given the readers the benefit of his rich experience in the form of a fine analytical account of their working. The book is warmly recommended both to designers and to users of computing machines.

## HILSA INVESTIGATIONS IN THE NARBADA*

TWO of the most important families of fish as food for mankind are the Clupeoids (Herring family) and Gadide (Cod family). The latter family is practically unrepresented in Indian water, but the Clupeoids are abundant. Quite a number of members of the Salmon and Herring families live parts of their lives in the sea, ascending rivers to a greater or less distance to spawn. Some spawn near the termination of the tidal rise, others ascend the rivers for vast distances. The striking result of this is that these fish, when overfishing takes place, are more amenable to depletion than fish which spend all their lives in the open sea. Consequently, information as to the spawning habits of these fish is of direct economic importance, and Dr. Kulkarni in these researches is to be congratulated on extending our knowledge of the spawning of the Hilsa, certainly one of the most important, if not the most important, of Indian fish.

It has long been known that the Hilsa ascend certain Indian rivers, *e.g.*, the Ganges to considerable distances and it was reasonable to assume that this migration was for spawning purposes. In June and July 1909, the writer of this review attempted to locate spawning ground of Hilsa in the Ganges without success, though ripe males and females which had evidently recently spawned were obtained at Sara Ghat, Rajmahal and Monghyr. In spite of the most careful search no eggs or larval fish were obtained. Late in September ripe males were obtained at Monghyr. So the mystery of the spawning grounds of the Hilsa remained unsolved until Dr. Hora in 1938 discovered spawning grounds at Pulta.

Now we have, thanks to Dr. Kulkarni, a detailed account of the spawning habits, eggs and young Hilsa from the Narbada. It appears that many, if not most, shoals of Hilsa in that river spawn at or about tidal limits in this respect resembling the Smelt (Salmon family) of English rivers. The author gives an excellent, lucid and detailed account of the eggs and young of the Hilsa with illustrations. There is also a map showing the positions where the eggs were obtained. All this information is most valuable, and should overfishing occur, as it may well do, the author's paper will be reliable as a source of any regulations that have to be made. The excessive preponderance of ripe males to females corresponds with our experience on the Ganges. A more detailed account of the extent of the spawning grounds in the Narbada River and also the fate of those shoals which ascend the river to Garudeshwar will be quite useful.

Dr. Kulkarni rightly draws our attention to the fact that while the Hilsa spawns relatively near the tidal limits on the west coast, it does ascend to considerable distances in the Ganges and Indus, even though a spawning was discovered by Dr. Hora at Pulta. We know that in the case of the two European Shads, one ascends rivers to a considerable distance whereas the other spawns near tidal limits. Can it be that there are two varieties of Hilsa, one the same as the above, while the other spawns immediately on reaching fresh water? There is also the question of the development and location of what may be termed the post-larval stages of the Hilsa. My own experience was that little or nothing was known of these stages. The duration of the spawning period should also be investigated.

J. T. JENKINS.

* *Breeding Habits, Eggs and Early Life-History of the Indian Shad, Hilsa ilisha (Ham.), in the Narbada River.* By Dr. C. V. Kulkarni, (*Proc. Nat. Inst. of Sciences of India*, 1950, **16**).

# SCIENCE NOTES AND NEWS

### International Conference on the Use of Atomic Energy

An international conference for the exchange of information on the beneficial uses of atomic energy is to be held in Oxford from July 16 to 21. The conference will be devoted to reports by users of radioactive isotopes on the techniques employed and results obtained. Industrial, medical, agricultural and other research uses of isotopes will also be discussed.—

### Cosmic Ray Investigations in Antarctica

Australia is planning a new physics station for cosmic ray observations, and other scientific investigations on the shores of the Antarctic Continent. The new station will supplement and extend the scientific and meteorological work now being carried out at Macquarie Island. Two different series of observations on cosmic radiation have been proceeding at Macquarie Island, and the observation post still further south, is expected to increase the value of the work.

### Dr. B. Mukerji

The appointment of Dr. B. Mukerji as Director, Central Drug Research Institute, Lucknow, in succession to Sir Edward Mellanby, has been announced.

### Zoological Society of Bengal

At the Fifth Annual General Meeting of the Zoological Society of Bengal, held on 6th May, the following Office-bearers were elected for 1951-52: *President*: Prof. H. K. Mookerjee; *Vice-Presidents*: Dr. M. O. T. Iyengar and Dr. Alexander Wolsky; *General Secretary*: Sri. G. K. Chakravarty; *Treasurer*: Sri. M. M. Chakravarty; *Editor*: Sri. J. L. Bhaduri; *Secretary for Foreign Correspondence and Publications*: Dr. S. P. Ray Chaudhuri.

### Zoological Society of India: Calcutta Branch

The Annual General Meeting of the Calcutta Branch of the Zoological Society of India was held in Calcutta, on 3rd April 1951, when the following Office-bearers were elected for the year 1951: *Chairman*: Dr. S. L. Hora; *Secretary*: Sri. A. G. K. Menon.

### Building Research Congress

More than a thousand delegates have already accepted invitations to attend the Building Research Congress to be held in London in September. They include the Directors of Building Research of ten Commonwealth and continental countries and official representatives of many colonial and other countries.

### Royal Institute of Chemistry: Bangalore Section

At the Second Annual Meeting of the Bangalore Section of the Royal Institute of Chemistry, held on 5th April 1951, the following Officers were elected:

*Chairman*: Prof. K. V. Giri; *Vice-Chairmen*: Mr. H. Shiva Rao and Dr. C. V. Natarajan; *Hon. Treasurer*: Mr. I. S. Patel; *Hon. Secretary*: Dr. T. L. Rama Char.

### Science Progress in India: 1938-50

Dr. S. L. Hora, Director, Zoological Survey of India and General Editor, Section of Zoology, writes that the National Institute of Sciences of India has decided to publish a book entitled *Progress of Science in India*, covering the period from 1938-50. Persons interested are requested to pass on the relevant information to the following Sub-Editors, dealing with respective sub-sections as indicated: Dr. N. K. Panikkar, Chief Research Officer, Central Marine Fisheries Research Station, Mandapam Camp, South India (*Fish* and *Fisheries*); Dr. G. S. Thapar, Department of Zoology, Lucknow University (*Parasitology*); Dr. M. L. Roonwal, Forest Research Institute, Dehra Dun (*Entomology*); and Dr. B. S. Chauhan, Zoological Survey of India, 34, Chittaranjan Avenue, Calcutta-12 (*General Zoology*).

### Validity of UNESCO Coupons

The validity of all UNESCO Coupons has been extended for an indefinite period. All coupons at present in circulation, irrespective of their date of issue, will remain valid until such time as UNESCO recalls them by public announcement, allowing a 6-months' interval for the return of the coupons.

A statement to this effect is incorporated in the text of the new UNESCO Coupons referred to above. It is emphasized, however, that the same validity terms are applicable to all coupons at present in circulation, irrespective of their date of issue.

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